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Pacific Ocean Cables. INTERRUPTION last week of telegraphic communication between England and the East directed attention so forcibly, dispatches say, to the need of a Canadian Pacific cable, that there is now great likelihood of an early execution of the work. We give on another page a table of estimates as to length and cost of the routes proposed. While the matter is one of vital interest to England, it is of great importance also to America and our growing Pacific trade.

The Study of Lightning. THE development of instantaneous photography has stimulated many studies which have been neglected for a long time, and, on the other hand, has created new ones never before contemplated. Thus in the study of lightning flashes the instantaneous photograph has not only completely changed our preconceived ideas on the appearance of lightning, but has already shown so much that lightning may now be divided into six distinct classes, according to its appearance as revealed by the camera. The results obtained thus far are not yet adequate for the formulation of laws governing the conditions under which various kinds of lightning manifest themselves, but a good start has been made. As an illustration of the work that can be accomplished in this direction we reproduce on another page a photograph of a lightning stroke taken by Mr. L. W. Serrell, Jr. The latter's simple directions will enable any one to duplicate this result.

Electric Light Wiring. A SHORT time since we published a diagram showing the size of wires required for a certain fall of potential. We distinctly pointed out at that time the restrictions under which that table was to be employed. In this issue, again, we place before our readers a very valuable table, calculated by Mr. George B. Prescott, Jr., and published by an enterprising firm. The caution which we brought forward needs to be repeated, but only to point out that the table published in this issue is based on a fall of one volt of potential. Being thus reduced to unity, the values can easily be converted into any other "drop" by simple multiplication or division, as the case may be. Thus it allows of a wide range of application, and will undoubtedly prove of value to many engaged in the distribution of electric light and power. While the table skips many intermediate values, it will be noticed that both the ampère capacity and the number of feet calculated are such that by suitably combining them any desired number of either can be obtained.

The Subways of New York. THE relations between the lighting companies and the Board of Electrical Control in this city have at last reached the point at which phrase mongering ceases and there is an actual test of strength. It must be admitted at once that the position of the Board with public opinion and the power of the police supporting it is a very strong one, and is not likely to be weakened. On the other hand, the lighting companies are within their rights in asking, and would be failing in their duty if they did not ask, that the subways they are ordered into shall be in a fit condition to receive them and shall allow of proper service being given. Many of the subways are mere water pipes, and we should ourselves desire to be excused from the operation of arc systems through wet conduits. Furthermore, no provision has yet been made practically, though it may exist on paper, for way distribution, and even when it is made, the price charged for it should be in keeping with the use and revenue enjoyed by the company. We sincerely trust that some terms of peace and conjoint working will soon be arrived at, and that New York will be able to show other cities, instead of having to learn from them, how best to put the wires underground. What we would deprecate is the assumption that a successful burial of the wires is beyond accomplishment. That is as far from the facts of the case as is the other contention, that past experience yields a complete solution of the many serious problems involved. There have been a few successes and numerous costly breakdowns, and the general result is one of advance and improvement. Part of the subway work in this city already done is doomed to dismal failure; but we are inclined to expect much from other portions of it.

Graphophone and Phonograph. NOT a few persons interested in the evolution and perfection of the phonograph have been anxious to learn what are the claims made in behalf of the graphophone and what are its distinctive merits. The article by Mr. Charles Sumner Tainter, accompanied by several illustrations, which we publish this week, on the graphophone, will answer a great many questions, and will, from its directness and fullness of statement, present the case very plainly. Taking Mr. Gilliland's paper, read not long since before the New York Electric Club, as the authoritative utterance in regard to the new phonograph, Mr. Tainter at once joins issue, and, as the inventor of the numerous improvements embodied in the graphophone, he puts his own contentions and opinions on record, citing his references by chapter and verse. It may be pointed out that Mr. Tainter lays broad claim, under his patents, to the highly important method of obtaining the registration of speech or sound by the cutting or engraving into a waxen surface, as distinguished from the practice with the old phonograph of indenting the record into a sheet of tinfoil or similar substance. This will surprise many persons. It is understood that the companies controlling the two machines and the patents thereto relating have united their forces, and that being the case, there will evidently be no delay in giving the public the benefit of the phonographic art in practical, commercial form. We believe that in a very short time phonographs and graphophones will be as plentiful as typewriters or telephones, and will be applied to much work that is new. It is the promise of the machine in connection with telephony as a recording apparatus that gives it so much value in the eyes of electricians, besides the fact that it is altogether the product of inventive genius in the electrical field.

Discontent Among Operators. FROM various quarters there come reports of discontent among operators, and it is even said that the feeling may evince itself in a strike. The great trouble with the telegraphic service is that it is overcrowded, and that the glut of good men, always a noticeable feature, is even more marked now that competition among those who employ operators is at a minimum. In fact, it sometimes looks to us as though the periods of competition were, in the long run, the worst part of the business, because by raising salaries temporarily and inducing recruits to enter the field, they serve only to intensify the struggle and distress when combination is again the order of the day, and when by the consolidation of forces and the closing of hundreds of offices, the chances of remunerative occupation are reduced to what must be called the normal state. At the present time, the operators are none too well paid, while their hours are long and the work is exacting, but how a strike would remedy this state of affairs, even in a year of political activities such as this, we do not quite see. Unless we are greatly misinformed, there are a large number of persons familiar with telegraphy who would be ready to fill at once the positions vacated, and hence a strike might be highly disastrous to those engaged in it. In fact the low rates of pay among operators are mainly due to this fact, and if the conditions were otherwise salaries would at once advance. Better far than a strike would be some effective discouragement of the swarms of beginners who are cajoled into learning telegraphy by lying stories, and who become operators only to cheat themselves and help starve others already at the key.

A Novel Motor. THE motors of the Gramme and Siemens type of armature excel in efficiency so much all motors previously designed that it has almost come to be looked upon as futile to attempt to obtain power from a machine in which these forms are not employed. Yet we still see work going on in this direction, and the motor of Dr. Lugo, described in another column, certainly deserves attention in more respects than one. While the motor appears a familiar one to those who are conversant with the older types of machines, it will, nevertheless, be found to embody a principle of decided novelty. It is evident that in order to obtain a practically continuous pull upon a machine of that construction the number of magnets, both on the armature and field, if the old principle were utilized, would need to be very large, so as to get an effective pull at very small intervals of revolution. The new motor is intended to overcome this great difficulty by an ingenious system of commutation, by means of which a very small number of magnets are so connected as to exert a practically continuous pull through the entire revolution of the armature. Dr. Lugo also lays stress on the additional effect obtained by the inter-action of the current passing through the bobbins, independent of the cores. Dr. Lugo maintains, too, that the motor avoids the generation of Foucault currents, and that in this way much waste of power is prevented. This, of course, is based on the undoubted fact that while Foucault currents from a dynamo merely absorb power, in the motor they not only absorb power, but their direction is such as to actually oppose the direction of motion, and thus they are doubly disadvantageous.

Electric Light versus Kerosene. IT has heretofore been supposed that the one rival of the electric light is gas; but we are now furnished an example in which the cheapest kerosene has actually been profitably replaced by the electric light. It has long been suggested that electric lights are eminently adapted for railroad signal purposes, but the idea seems to be slow in gaining possession of the minds of railroad superintendents. It is gratifying to note, however, that Mr. W. W. Slater, Master of Signals of the Southern Pacific Railroad at Oakland, Cal., has inaugurated a practice which, we believe, must soon be followed in a great many instances. In the *Railroad Gazette* Mr. Slater describes the manner in which the signals in the yards have been fitted up with incandescent lamps, for which purpose he employs normal 16 c. p. lamps, run up to 12 candles. This light of 12 candles, passing through the corrugated lens of the lantern, gives a bright, clear, steady beam, strong enough for all practical purposes. The reduced candle power at which the lamp is run insures a long life for the lamp. The result is shown by the fact that these lamps, without any difficulty of attention other than occasionally cleaning the glass lens on the outside of the lantern, have been burning over 2,600 hours up to date, or a portion of every night for one year and 16 days; and, according to Mr. Slater, they are probably good for another year. All this lighting, in addition, is done without a current governor, or regulator on the circuit, the current being furnished from arc machines, and the lamps placed in multiple series. It is interesting to note that, as above stated, the electric lighting has proved cheaper than kerosene, for Mr. Slater shows that the average cost of one oil lamp for one month is 65 cents, for oil and labor in cleaning, filling and lighting, and about 25 cents for depreciation of lamps and lamp burners; whereas the average cost of the electric light, with one lamp, for one month, is 30 cents. For the loss by depreciation of lamps and machines, oil, waste, etc., there are no data on which to base an estimate, but according to Mr. Slater the amount is inconsiderable when taken in connection with the other lights employed at the station. With proper machinery, regulation, etc., it seems probable that the cost of coal could be reduced one-half. Again, the original cost of wire and material for an electric light plant compares favorably with the cost of expensive oil lamps. All these advantages must be taken, too, in connection with the fact that engineers express themselves as much pleased with the electric lights and signals; that the signals are always lit, and the light is always brilliant; that there is no dirt or smoke; while, on the other hand, the oil lamps are hard to keep burning; invariably drafts of air cover the lamps with smoke and carbon, and the signals with oil and dirt; and not unfrequently go out, and have to be relit. It is not difficult to discern that electric-light signal lanterns will be employed in many railroad yards, as soon as their value is recognized, which now seems to be the case.

NEW BOOKS.

HALL'S PATENT ESTATE. By Thos. B. Hall. Ingham, Clark & Co., Cleveland, O. Sheep. Octavo. 240 pages.

The subject of patent law has, even recently, been treated by authors as a general subject, and until of late years, indeed, there has been but little call or material for special discussion. The number of patents granted, however, and the consequent increase of patent litigation, has been productive of new questions and widened to a considerable extent the meaning of the old ones.

This work is a special treatise on the character of property under a patent grant, its legal surroundings and extent. The subject is treated under various heads in such a clear and concise manner that the work is sure to receive the attention of bench and bar. The impression prevails to some extent that a "patent right" secures to the patentee ownership in a corporeal thing. The author corrects this idea by clear reasoning based upon decisions. A patent is a grant of exclusion or debarment, giving the patentee an exclusive right to make, use and vend his invention for a certain time and within a certain territory, and debarring all others from making, using and vending. An invention is not a product of the hands but of the mind. It is, therefore, intangible in itself, but is of avail through the medium of matter.

One chapter is given to "Profits of Property Rights of Patents." The property of a patent is compared to that of a share of stock. It is a mere ideal thing, a property existing only in legal contemplation, a claim. "The owner of a patent does not at any time have the thing which the property gives him right to have; such thing being the debarment in fact of the making, using and vending the invention without his authority."

The question of the Partition of Patents is discussed, and the position is taken that one part owner may have partition of the patent. Warrant for such a position is found in the many references given, and if this should become adjudicated law a large mass of co-owned property now unproductive to certain of the co-owners must be placed in severalty. Considerable space is given to "Account and Infringement between Patent Part Owners." Incalculable interests are involved under this head. The decisions cited and conclusions given must have a bearing on ultimate decisions of these important matters. Under "Grants" and "Limitation of Sectional Grants" many difficult questions hitherto confused and involved are disposed of. It would seem that a patented article cannot be lawfully used or sold within the territory of a sectional grantee, except through him; and this, irrespective of such article having been made and originally sold by an independent sectional grantee within the latter's territory.

The book also contains an appendix giving six leading opinions not found in technical patent reports, besides a conveniently arranged table of cases cited, and a general index of subjects.

AIDE MÉMOIRE DE L'INGENIEUR-ELECTRICIEN. First year 1888. By G. Duché, E. Meylan, B. Marinovitch and G. Szarvady. Paris, 1888: Bernard Tignol. Cloth, 420 pp., 4½ × 7 inches.

In this work the authors have avoided the mere bringing together of a number of rules and practical formulæ for the use of electricians, as they have wisely considered that such a compilation alone does not meet the daily wants of the electrical engineer. With the larger object in view, that of supplying the needs of the latter class, they have sought to provide specially what may be called an aid to the electrical engineer as distinguished from the old time electrician, who, however, is by no means neglected.

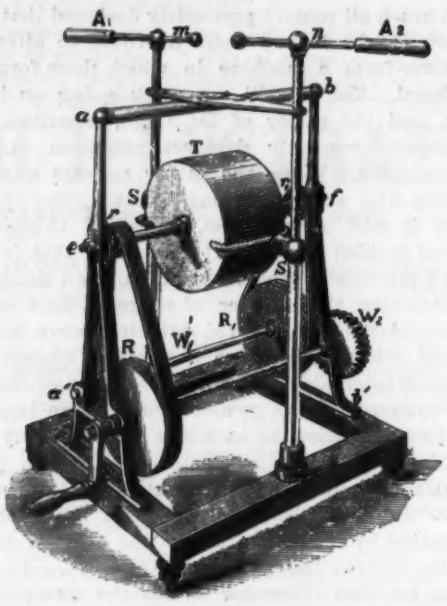
Accordingly the work is divided into two parts, the first being devoted almost exclusively to the fundamental physical laws and constants, including the laws of electricity and magnetism, the electrical and mechanical units, mechanics, heat, optics, sound, etc. The second and larger part begins with a chapter on electrometry, which serves as a link between the two divisions, and in which all the usual methods of electrical measurement are given.

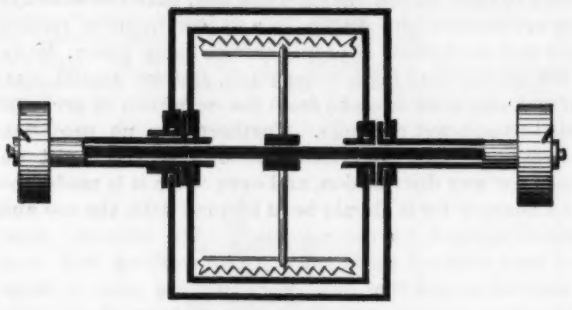
This is followed by what must be considered a new departure in books of this class, in that a chapter is devoted to each of the principal branches of electrical industry. These chapters include dynamos, transformers, transmission of power, primary and secondary batteries, electrolysis, electric light, conductors, telegraphy and telephony, and in them there has been sought to embody the results of the latest and best practice in a condensed and available form.

The authors have thus also divided their work into two parts, viz., theory and practice, and they have succeeded in gathering in the latter a large mass of information which is scattered through many different sources. The book is illustrated by numerous diagrams, and the only defect which requires remedying is the lack of careful proof-reading.

GESCHICHTE DER TRANSFORMATOREN. By F. Uppenborn. Munich. 1888. R. Oldenbourg. Paper. 44 pp., 6 × 9 inches. Price, 75 cents.

The lively discussions which have been created by the appearance of the transformer in the field of electric applications makes the appearance of this little brochure on the history of the transformer eminently timely. The author, who has evidently taken considerable pains to derive his information from original sources, details the various steps in the development of the induction coil from Faraday down to the present date, thus including both types, namely, those converting from low to high potential and *vice versa*, from high to low. Herr Uppenborn does not merely give a bald history, but intersperses his narrative with many valuable critical remarks and discussions which bear particularly upon the questions of priority in modern methods of alternate current transformation and distribution, and which cannot fail to interest those pursuing this development. The little book is well illustrated, and printed in large, clear type.





FIGS. 1 AND 2.—GLAESER'S STATIC ELECTRIC MACHINE.

The Glaeser Influence Machine.

Hermann Glaeser, an instrument maker of Vienna, has recently brought out a new influence machine of somewhat novel construction. This machine, which is chiefly intended to be used to free air from dust or other impurities, is shown in perspective in the accompanying engraving, Fig. 1.

The iron supports $a\,a'$ and $b\,b'$ are screwed to a four-legged wooden frame, their tops being joined together by the vulcanite rod $a\,b$. These two uprights support the axles $e\,f$, W_1 and W_2; $e\,f$ is fixed, and is made of steel. Upon $e\,f$ are two vulcanite collars, one of which is joined to the pulley r, and the other to the pulley r_1; at the middle of these two collars are two ebonite cylinders T, one within the other, as shown in section in Fig. 2. The internal cylinder, which is 8 mm. smaller than the first, is connected to the pulley r_1. The two lower axles W_1 W_2 each carry a large pulley R and R_1 and a toothed wheel. The axle W_2 carries in addition the handle M. The pulleys r R and r_1 R_1 are united respectively by belts, allowing r R_1, W_2 and T to in turn the same direction as M, and r R, W_2 and the internal cylinder in the reverse direction. The wooden frame also carries two uprights, which are partly of glass and partly of metal, terminating in the metallic knobs m n. In the middle of these supports are two metallic knobs, S S, each carrying a collecting comb in close proximity to the external cylinder. The fixed steel axle $e\,f$ carries a vertical metal rod inside the cylinder, Fig. 2. At each end of this rod there is a comb, which is at right angles to the corresponding external one. The two exciters A_1 A_2 are movable inside m and n.

The machine requires to be excited by external means, and one peculiarity of its action is said to be the large quantities of ozone generated by it. It is also said to act very well in damp weather.

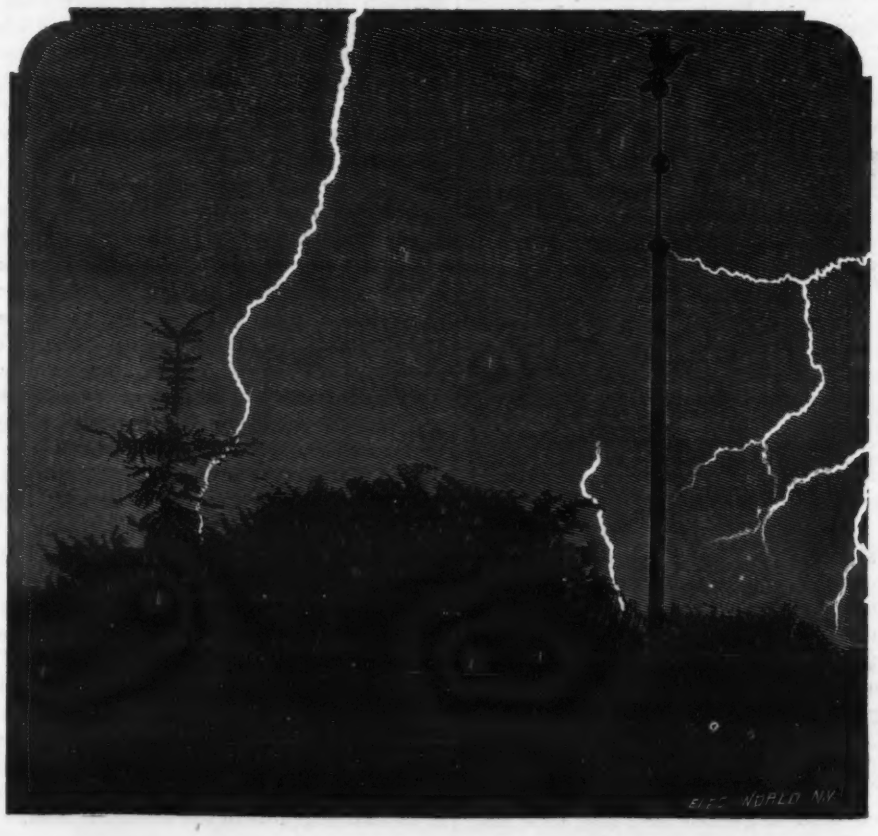
Photographing Lightning.

BY L. W. SERRELL, JR.

Various means have been employed in the past to catch the lightning, and while our old friend Ben Franklin tried to catch it with a kite and store it up in glass jars, and afterward experiment with it and see what effects could be produced by it, we of the present age may resort to a somewhat different manner of catching it, namely, by the use of a camera. While this means may not possess such great potency as Franklin's methods, nevertheless by it we are able to reproduce its effects.

The accompanying engraving, made from a photograph taken at Plainfield, N. J., during the heavy storm of June 15, shows vividly the track of this fiery monster through the heavens, and I have no doubt that many of those who look at the illustration will immediately ask themselves, "Well, how could they photograph lightning?" Let me tell them.

In the first place, as if your deeds were evil, you must choose a very dark night, and select some place for operations near the housetop, preferably under cover. Here place your camera, and point it towards that portion of the sky that looks the most promising. taking in at the same time a small portion of the horizon. Adjust the focus of the lens by a mark previously made upon the rack of the camera for such a distance, and after putting the plate-holder in and removing its cover, take the cap off the lens and let the camera stand. A very rapid plate should be used, and the lens should be given full aperture.



A PHOTOGRAPH OF LIGHTNING.

If nature is in a mood to please, she will now let off some of her fireworks in front of your camera, and they will take themselves. But if she be coquettish and coy, she will blaze away on all sides of the field of your lens, while the reflections of the flashes will fog your plate without a single flash being caught. Thus you will see that you will have to use your judgment in making the exposure, so as not to allow the plate to become unduly fogged by the sheet lightning. In such a case the ordinary development is applied, and the usual result is a fogged negative without any flashes upon it.

Three plates were exposed on the evening in question, and that from which the engraving is made was the only successful one taken.

The Lugo Motor.

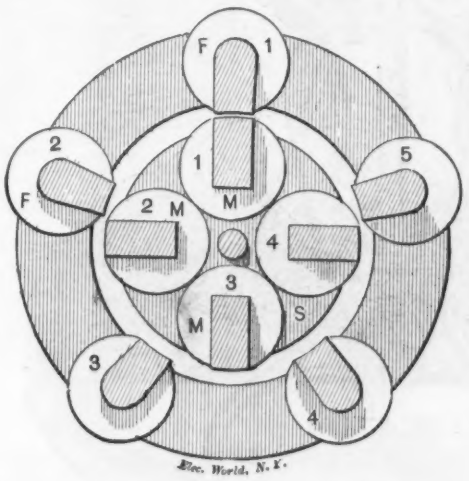
In discussing the various methods by which motion can be obtained with combinations of magnets and wires carrying currents, Faraday, in his "Researches," remarks that "the motion between two poles and two dissimilar wires (helices) is an instance where several powers combine to produce an effect." It is upon this principle that Dr. Orazio Lugo, of this city, has constructed an electric motor which embodies a novel principle which seems destined to a wide application.

The new motor of Dr. Lugo is constructed so as to utilize the maximum effects found in placing moving solenoids in proximity to fixed solenoids in such relation that, as the armature coils move, a maximum number of lines of magnetic forces is cut in the passage of each armature bobbin past each field magnet bobbin, and these effects are made successive, so that there is a continued application of such successive effects. And, in addition to utilizing these effects, due to a specified relation of the solenoids themselves, the combined effects of these solenoids and their cores also are employed.

By creating successive magnetic circuits through suc cessive armature and field bobbins in pairs until the series has been gone through once in each complete revolution of the armature, each armature bobbin being in circuit at least once in a complete revolution with each field magnet bobbin, and all of the bobbins, both of the armature and field magnets, being allowed to rest magnetically by being cut out of circuit during a fraction of each revolution of the armature, the evil effects of Foucault currents are said to be largely avoided.

The motor, which is of very simple construction, is shown in perspective in Fig. 1 and in cross-section in Fig. 2. As will be seen, it consists of a series of bobbins arranged in a circle to the number of five, and within which there revolve four similar bobbins attached to the shaft of the motor. All these bobbins are provided with cores and short pole pieces, which revolve in close proximity to each other.

The revolving armature coils are connected to a commutator fixed to the shaft, upon which bears a stationary brush B^1, shown in the end view, Fig. 3. The connections of the individual armature bobbins to the commutator are seen in Fig. 4, which shows also the cross-connection between the commutator strips. The other side of the armature shaft carries a revolving brush, which bears against a fixed commutator to which the field bobbins are connected. This is shown in the end view, Fig. 5, and the commutator in detail in Fig. 6. Finally, Fig. 7 shows the circuits diagramatically, with the bobbins laid side by side, and showing the manner of their connection one with the other.



Elec. World, N.Y.

FIG. 2.—THE LUGO MOTOR.

It will now be readily understood that if a current be passed through the armature and field bobbins M^2, F^2, the pole pieces are in such a position as to cause M^2 to be attracted to F^2 and cause rotation in the direction of the hands of a watch. This attraction continues until the pole pieces M^2, F^2 have arrived exactly opposite each other, or in the position in which M^1, F^1 is shown. At this instant, however, the current is shifted to the bobbins M^3, F^3, which will then have arrived at the relative position formerly existing between M^2 and F^2, and the magnets act in succession as follows: M^4, F^4; M^1, F^5; M^2, F^1; M^3, F^2; M, F^3; M^1, F^4; M^2, F^5; M^3, F^1; M^4, F^2; M^1, F^3; M^2, F^4; M^3, F^5; M^4, F^1; M^1, F^2; M^2, F^3; M^3, F^4; M^4, F^5, and back to the starting point M^1, F^1.

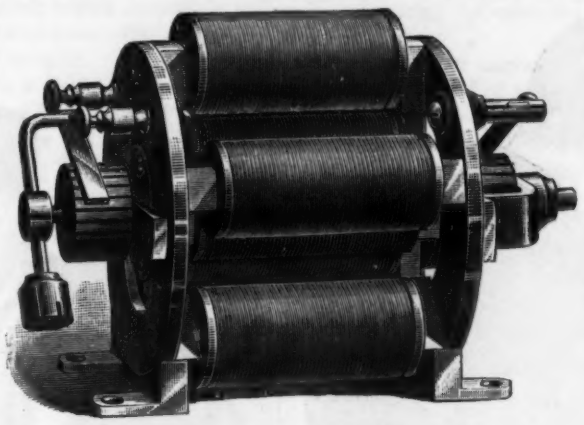


FIG. 1.—THE LUGO MOTOR.

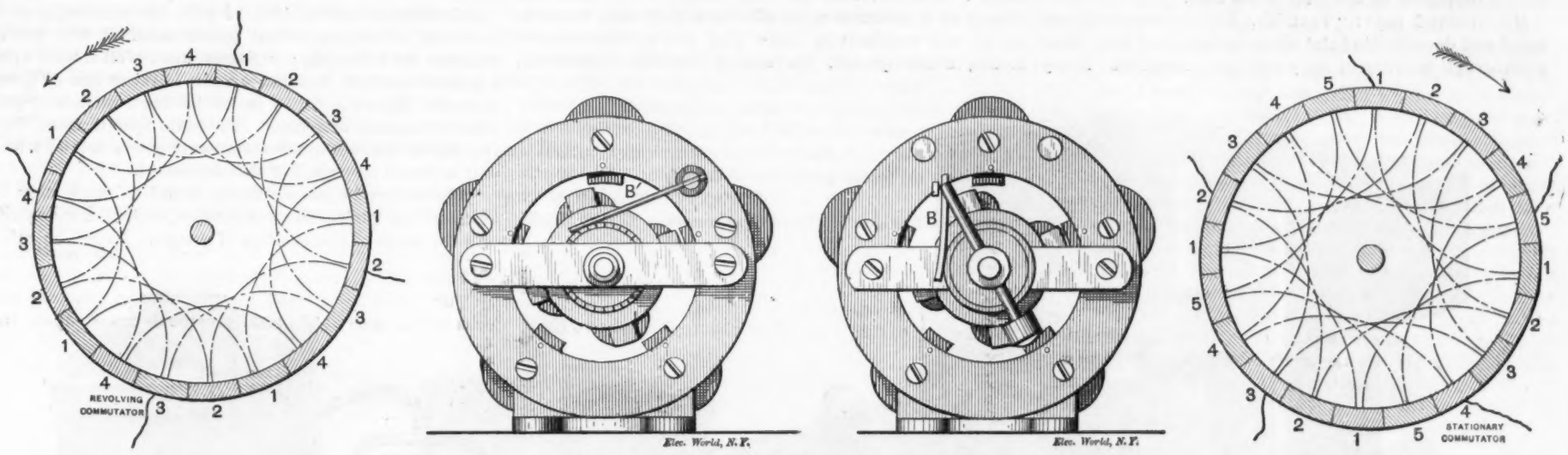
Thus in every revolution of the armature shaft each armature coil is placed in circuit with each field coil; and, there being four of one and five of the other, it follows that there are twenty successive pulls at as many radial positions of the shaft, each pair of coils being in circuit successively only during one-twentieth of a revolution of the shaft. It will be noticed that the stationary commutator is divided into four groups of segments, five in each group, while the rotating commutator is divided into five groups, each of which has four segments. An examination of the circuit diagram, Fig. 7, will show the commutation of the four armatures and five field bobbins. It is evident, however, that any desired number of field and armature bobbins may be combined, it being only necessary to so commutate the circuits as to make the effect of the magnetic pull on the bobbins successive in its action.

With a motor constructed in the manner just described, Dr. Lugo claims to utilize the power due to the attraction of the pole pieces of the armature and field magnet bobbins, as well as that due to the parallelism of the windings of the bobbins as they approach each other during the rotation of the armature, thus obtaining an increased effect from those magnetic lines of force which are ordinarily radiated to create reverse inductive effects detrimental to the efficiency of the machine.

The arrangement is also claimed to avoid the evil effects due to self-induction, for the reason that only a minimum amount of effective wire is in circuit at any time, and that, only, at the time when it is needed to give the best effects. By creating the effective field and armature circuits at stated intervals and only when needed, and permitting all of the field or armature bobbins to rest or be magnetically or electrically discharged at different portions of the armature rotation, heating and waste of energy is said to be prevented. The Foucault currents are also reduced to a minimum by reducing the effective field and armature circuits with their magnetic cores to a minimum while obtaining their maximum effect. The sparking at the brushes is likewise avoided by reason of the fact that there is no magnetic lead in the field or armature, inasmuch as the field travels around just in advance of the armature as each bobbin is cut in.

Among other novelties which the machine is claimed to possess by the inventor is, that both field and armature circuit are conjointly cut out at different points in the rotation of the armature, thereby utilizing only that portion of the combined circuit which is needed to propel the motor or create a current in the machine when used as a dynamo.

The efficiency of this motor is said to be very high, and the machine very light and simple in construction.



FIGS. 4, 3, 5 AND 6.—DETAILS OF THE LUGO MOTOR.

Report on Thunderstorms.

At a recent meeting of the Royal Meteorological Society the first report of the Thunderstorm Committee was read. The report deals with the photographs of lightning flashes, some sixty in number, which have been received by the Society. From the evidence now obtained it appears that lightning assumes various typical forms, under conditions which are at present unknown. The committee consider that the lightning flashes may be arranged under the following types: 1. Stream. 2. Sinuous. 3. Ramified. 4. Meandering. 5. Beaded or chapletted. 6. Ribbon lightning. In one of the photographs there is a *dark* flash of the same character as the bright flashes, but the committee defer offering any explanation of the same until they get further examples of dark flashes. As the thunderstorm season is now coming on, the committee propose to publish their report at once, along with some reproductions of the photographs by the autotype process, in order that observers may be prepared to notice the various forms of lightning.

An Electro-Chemical Radiophone.

In a communication to the Académie des Sciences, on the 4th ult., MM. Chaperon and Mercadier described a galvanic cell made by them which is sensitive to the action of light. It consists of a plate of bright silver, and a plate of silver, covered by the electrolysis of sulphide of sodium, with a thin layer of sulphide of silver, immersed in some electrolyte other than an alkaline sulphide, water containing a trace of sulphuric acid being as good as anything. The E. M. F. is very feeble and variable, and the cell polarizes very rapidly, but its current undergoes instantaneous change when exposed to daylight or even to weak artificial light. The authors investigated the rapidity of the action by exposing the cell to the beam of the oxyhydrogen light made intermittent by passing through a revolving wheel pierced with holes. A telephone was included in the battery circuit, and sounds were produced so high in the scale as to correspond to more than 1,000 vibrations a second, which showed that the electro-chemical effect must be produced in less than $\frac{1}{1000}$th of a second. No corresponding changes are observed in the resistance of the cell, so that the effect of the light must be to cause a variation in the E. M. F.

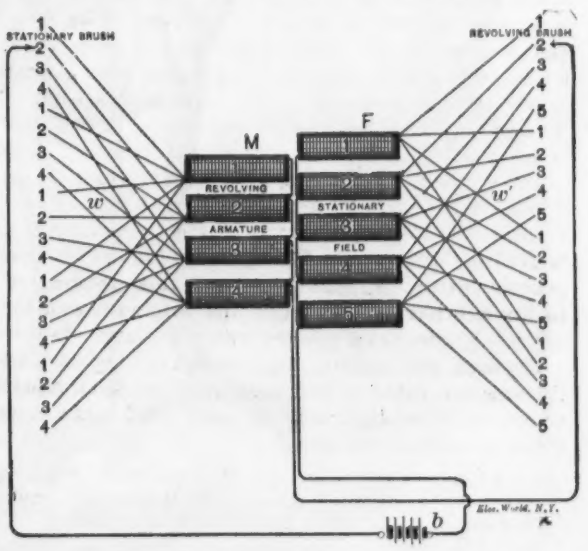


FIG. 7.—THE LUGO MOTOR.

Motor Winding of the Launch "Magnet."

To the Editor of The Electrical World:

SIR: Will you kindly inform me through your columns whether the motor of the launch "Magnet," described in a recent issue, is series or shunt wound? H. B. C.

FULTON, N. Y.

ANSWER.—The motor of the "Magnet" is series wound, having the two field coils coupled in parallel and joined in series with the armature.—EDS. E. W.

The Graphophone.

BY CHARLES SUMNER TAINTER.

In a paper on the phonograph read by Mr. E. T. Gilliland before the New York Electric Club on May 12, 1888, and published in THE ELECTRICAL WORLD of May 19, there are certain statements to which I take exception, as they are not supported by the facts in the case.

Mr. Gilliland says: "That Mr. Edison invented, patented and described in print all the essentials of the present phonograph instrument ten years ago." And that "Every "infringing machines," and, therefore, to be avoided by the public.

It is very important to all who will have occasion to use machines of this nature, either for business or pleasure, to be fully informed as to the exact quantum of truth embodied in these statements, for their own protection in the lawful ownership, as well as in the undisturbed use of such machines. It is therefore my wish to state a few facts, capable of easy verification by all whom they may concern, which will conclusively show that Mr. Gilliland's statements, above quoted, are simply without foundation.

FIGS. 1 AND 2.—THE ORIGINAL GRAPHOPHONE, 1885. IN OPERATION.

FIG. 4.—GRAPHOPHONE, 1886, MOUNTED ON STAND SHOWING TREADLE AND GOVERNOR.

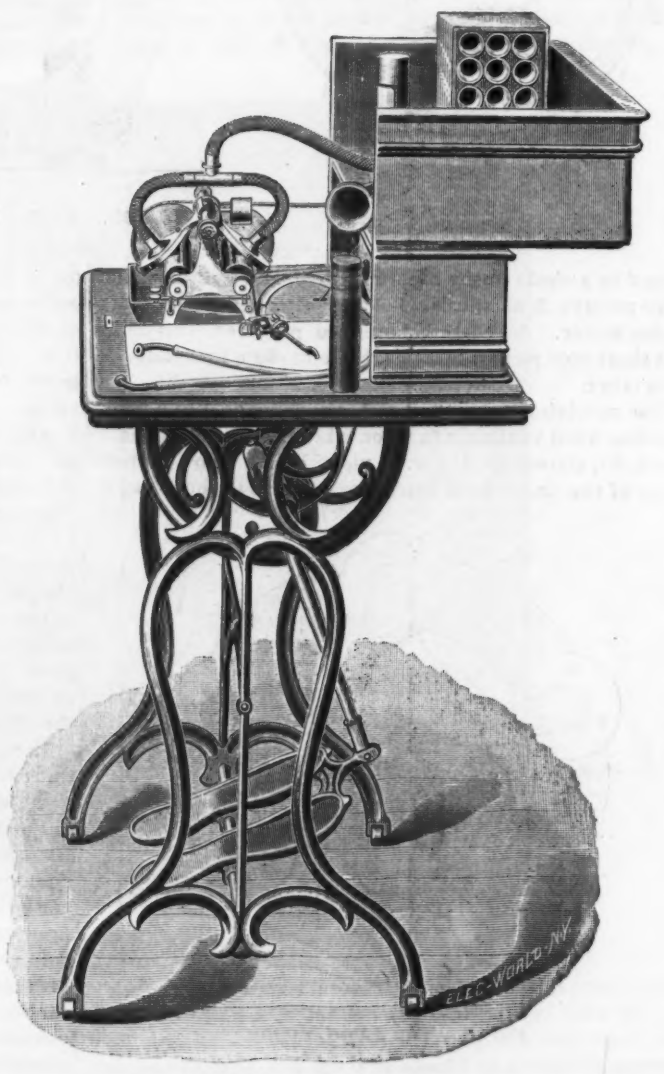


FIG. 7.—GRAPHOPHONE ARRANGED TO MAKE A DOUBLE RECORD.

principle embraced in the present improved phonograph is shown and described in these patents."

The manifest object of these statements is, of course, to create the impression in the public mind that the present development of the art of recording and reproducing sounds is due entirely to the work of Mr. Edison; that the "essentials" are covered by his patents vaguely alluded to as "The patents of 1878," and that any other apparatus having the same object, and employing those "essentials" are

The main feature of the so-called improved phonograph, and the "essential" of greatest value about the machine is the making of records of sounds by *cutting* or *engraving in wax*, instead of forming them by indenting a metal foil, which is the plan invented and employed by Mr. Edison until he adopted the method of cutting or engraving used for several years past in the graphophone. An examination of Mr. Edison's patents of 1878, which, according to Mr. Gilliland's statements, cover the cutting or engraving of records in wax, reveals the following: In his United States patents the only allusion to wax occurs in patent No. 200,521 of Feb. 19, 1878. The specification reads as follows: "The material employed for this purpose may be soft paper saturated or coated with paraffine or similar material, with a sheet of metal foil on the surface thereof to receive the impression from the indenting point."

In British patent No. 1644, of 1878, the same suggestion is found. The provisional specification of this patent contains the following: "Sometimes tinfoil is used upon a grooved surface; sometimes a thin sheet or leaf of metal is placed upon a piece of paper having a surface of paraffine or similar material." The main specification, filed Oct. 22, 1878, contains the statements given below, which will be found on page 7 of that document.

"The material upon which the record is made may be of metal foil, such as tin, iron, copper, lead, zinc, cadmium, or a foil made of composition of metals. Paper or other materials may be used, the same being coated with paraffine or other hydrocarbons, waxes, gums, or lacs, and the sheet so prepared may itself be indented, or the material, say paper, may be made to pass through a bath of hot paraffine and thence between scrapers. Thin metal foil is now placed on the material, and the sheet passed through rollers, which give it a beautiful smooth surface. The indentation can now be made in the foil, and the paraffine or similar material, and the indenting point, does not be-

come clogged with the paraffine in consequence of the intervening foil."

The utmost that can be made out of the above is, that Mr. Edison at that time conceived that he might substitute paper soaked in wax for the metal foil to receive the record formed by *indentation*, but, as the paraffine clogged the point of the style, he found that he could only use it as a backing for the metal foil.

The term *indenting*, as used by Mr. Edison throughout his patent specifications, clearly means the action of *embossing* or *shaping* the material without the removal of any part of it, as in forming a record in tin foil by pressing it into shape with the vibrating style. This method of forming records of sound vibrations is very defective, and the prospect of obtaining anything but a rough approximation to a true record by means of it, is beyond hope. The *cutting* or *engraving* process, in which the material is removed in the form of a shaving, is free from the defects of the indenting method, and greatly superior records are the result, as has been demonstrated for several years past by the graphophone, and now by the so-called improved phonograph, in which Mr. Edison has adopted this "essential," and made it his principal feature.

The indenting method is faulty in this respect, viz., the formation of each indentation in a metal foil alters the shape of the one immediately preceding, as the material bends backward as well as forward for some distance around the point of the style. This defect is more noticeable in records of speech, as the distortion is greatest in the finer vibrations which lend quality to the sounds. The records of music being simpler and more regular, are less affected by the apparently unavoidable distortion due to the indenting method, and this accounts for the fact that such records are found to reproduce much more clearly and accurately than records of speech.

The quotation given above from British patent No. 1644 includes everything relating to the use of wax I have been able to find in any patent or publication emanating from Mr. Edison, prior to the issue of the graphophone patents of May 4, 1886, two of which, Nos. 341,214 and 341,288, are directly infringed by Mr. Edison, in his so-called improved phonograph, as reference to the specifications and claims of these patents will show.

I do not undertake to quote all the twenty or more claims in our patents infringed by Mr. Edison, but only select a few of them for reference, to show how the "improved phonograph" has been perfected.

In patent No. 341,214, filed June 27, 1885, and issued to Chichester A. Bell and myself, the following claims among others were allowed:

Claim 1. "The method of forming a record of sounds by impressing sonorous vibrations upon a style, and thereby cutting in a solid body the record corresponding in form to the sound waves, in contradistinction to the formation of sound records by indenting a foil with a vibratory style, or cutting a strip by vibrating it against a revolving disc cutter."

Claim 3. "The vibratory cutting-style of a sound recorder."

Claim 4. "The cutting style, in combination with a support permitting the same to be vibrated, and means for impressing sonorous vibrations thereon."

Claim 7. "A sound record consisting of a tablet or other solid body having its surface cut or engraved with narrow lines of irregular or varied form corresponding to sound waves."

Claim 9. "The method of forming a sound or speech record, which consists in engraving or cutting the same in wax or a wax-like composition.

Claim 12. "The sound or speech record cut or engraved in a wax-like composition, such as the compound of bee's-wax and paraffine."

Claim 24. "The combination, with a sound record formed in wax or a wax-like material, of a reproducer

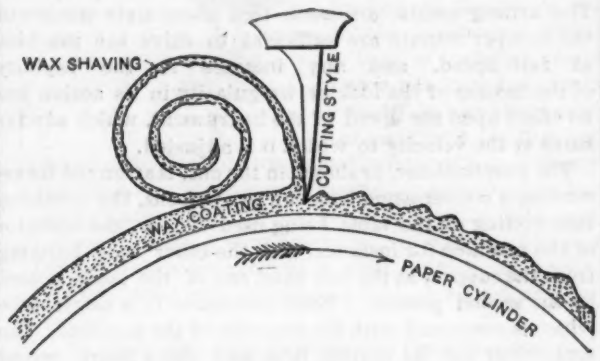


FIG. 3.—DIAGRAM OF GRAPHOPHONE RECORD AS CUT IN THE WAX.

having a rubbing style for receiving sonorous vibrations from said record."

In patent No. 341,288 filed Dec. 4, 1885, and issued to me May 4, 1886, the following claims will be found:

Claim 1. "A recording tablet for a phonograph, consisting of a hollow cylinder provided with a wax or wax-like coating for receiving the sound record."

Claim 4. "A tubular self-sustaining tablet for recording sounds or sonorous vibrations."

Claim 5. "In a phonograph and in combination with a sound recorder or reproducer and operating mechanism for causing the said recorder or reproducer to trace a spiral line on the tablet, an elongated cylindrical tablet holder supported and journaled so that the tubular tablet can be placed on the same."

Claim 6. "The combination, with a tubular tablet of a tablet-holder for supporting and rotating the same."

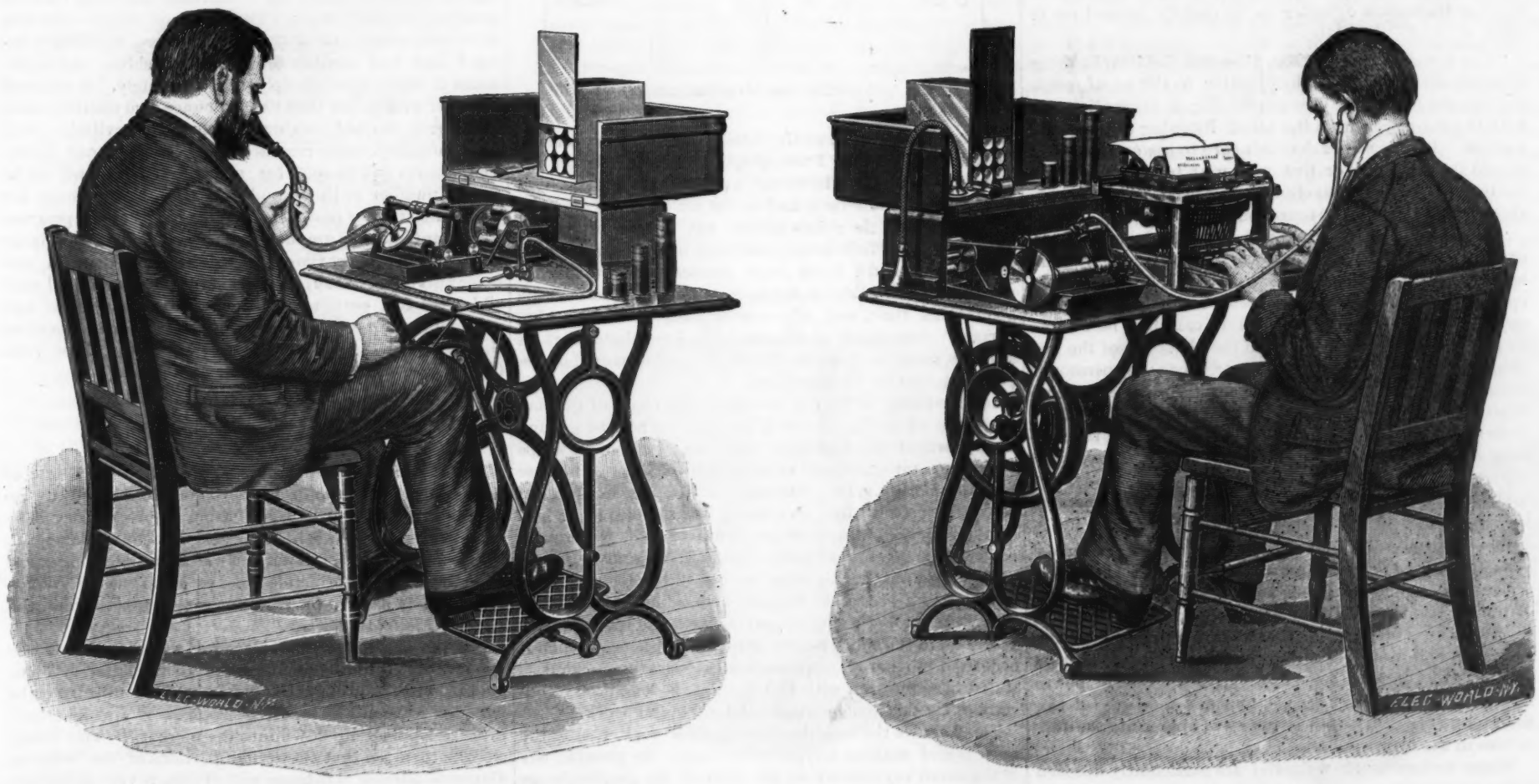
Claim 37. "A recording-tablet consisting of a hollow cylinder provided with a wax or wax-like coating and having a sound record cut in said coating."

Mr. Gilliland also states that "it has been asserted by some, and believed by a great many that the work of improving the phonograph was undertaken and accomplished not by Mr. Edison, but by other persons not connected with him." In view of what is given above, and the fact that machines under the name of graphophones using wax compositions for recording and reproducing speech and other sounds, have been in use for several years past; that a considerable number are in daily practical operation in business offices and other places at the present time, and that they are being eagerly taken as fast as they can be supplied, it is evident that the assertion quoted above from Mr. Gilliland, to which he takes exception,—that the work of improving the phonograph was undertaken and accomplished by other persons not connected with Mr. Edison,—is fully substantiated.

Mr. Gilliland also states that "on account of the rapid growth and extraordinary demand of the electric light business, etc.," "the work of perfecting and preparing the phonograph for manufacture has necessarily been slow. This work, however, was not laid aside, but has been steadily kept up till the present date."

In the summer of 1885, while in New York City on business, I exhibited to several members of the Edison Speaking Phonograph Company, a machine on which records of sounds were engraved and reproduced from cylinders of wax, in substantially the same manner as that used in the so-called improved phonograph of Mr. Edison. I was also shown at this time by a prominent member of the Phonograph Company a phonograph of large size, which, I understood, embodied Mr. Edison's latest ideas up to that time. It is very well described in Mr. Edison's own words in a characteristic interview published in the New York *World* of Nov. 6, and copied in THE ELECTRICAL WORLD of Nov. 12, 1887.

Mr. Edison's description is this: "It weighed about one hundred pounds; it cost a mint of money to make; no one but an expert could get anything intelligible back from it; the record made by the little steel point upon a sheet of tin-foil lasted only a few times after it had been put through the phonograph. I myself doubted whether I should ever see a perfect phonograph ready to record any kind of ordinary speech, and to give it out again intelligibly. But I was perfectly sure that if we did not accomplish this the next generation would. And I dropped the phonograph and went to work upon the electric light, certain that I had sown seed which would come to something." This, together with another statement of Mr. Edison, contained in the same interview from which the above is quoted, that he only resumed work on the phono-



FIGS. 5 AND 6.—GRAPHOPHONE, 1887, AS USED IN RECEIVING A DICTATION AND FOR TRANSCRIBING.

graph eight months before, and also with the fact that members of the Phonograph Company informed me in 1885 that they were trying to induce him to work on it, seems hardly consistent with Mr. Gilliland's assertion that "this work was not laid aside, but has been steadily kept up till the present time."

In view of the above it is hardly necessary to adduce other facts to contradict Mr. Gilliland's statements. It is well known, however, that the Edison Speaking Phonograph Company was formed upon the expectations created by this apparatus, with ample capital to work and introduce it commercially, which company is in existence today, and has been supplying the very limited demand that has existed in the intervening years for the Edison phonograph. This tells the whole story of the development

from 1878 to 1887, during which time the primitive apparatus of the former year was never materially improved.

The graphophone shown to Mr. Edison's associates in 1885 made a perfect record by engraving or cutting the same on the surface of a cylinder composed of a mixture of beeswax and paraffine, from which the reproduction was distinct and intelligible, and could be repeated indefinitely; in a word, it accomplished everything claimed for the so-called improved phonograph of Mr. Edison. This instrument formed the subject matter of Patent No 341,288, issued to me May 4, 1886, and was illustrated and described in an article in *Harper's Weekly* of July 17, 1886, from which article Figs. 1, 2 and 3 are taken.

The following description of the graphophone as it was at that time is copied from the article in *Harper's Weekly* above referred to:

"The Graphophone is made in two forms; one to make records upon a cylindrical surface, the other upon a disc or flat surface, the same principles, however, governing each machine."

"The machines are provided with two diaphragms; one used in making the record and the other in reproducing the sound. The cylindrical machine stands about five or six inches high by eight wide, and weighs about ten pounds. There is no skill required in the manipulation of the machine, the rotation of the cylinder being accomplished by a crank or automatic motion. Mr. Tainter has exhibited a great amount of ingenuity and skill in devising the various parts of the machine and suiting them to the purposes for which they were designed. The instrument is a marvel of perfection in accuracy of the movements of all its parts."

"Upon a diaphragm three inches in diameter a steel point is attached, which cuts a minute hair line in the surface of the waxed cylinder upon the agitation of the diaphragm by a sound.' 'The indentation is so slight as to be scarcely perceptible, and yet these records can be gone over time and again, and are just as perfect after a hundred repetitions as they were at first."

"The diagram (Fig. 3) gives an idea of the way the steel point cuts into the surface of the wax, and also portrays an actual sound wave. This figure is magnified three times, and there are one hundred and forty lines to the inch upon the cylinder.

"Upon a cylinder six inches in length by an inch and a quarter in diameter, one is enabled to record at least five minutes' conversation. The cylinder holder is constructed with a ball joint at one end, and can be easily tipped so as to allow the hollow cylinder to be rapidly slipped on or off." * * *

"The first illustration (Fig. 1) shows the Graphophone in actual operation, with the operator in the act of speaking into the machine. The second (Fig. 2) shows listeners with the ear-pieces on in the act of listening to the reproduction. If the listener does not care to use ear-pieces, or should there be four or five who wish to hear the reproduction, a trumpet attachment is placed upon the machine, which throws the sound out into the air."

"Either of these machines is in a condition *at the present time* to do the amanuensis work usually done by stenographers. For instance, any one may sit before the Graphophone and in ordinary tones speak his daily correspondence into the machine. His letters can then be written by a copyist who can write from the dictation of the machine. By a neat mechanical contrivance the operator is enabled to take as many words at a time as he can conveniently remember, and should he forget any part of the sentence, by a slight pressure of the finger on a rod running along the base of the machine the reproducer will repeat the sentence."

The graphophone shown in Figs. 1 and 2 was operated by hand.

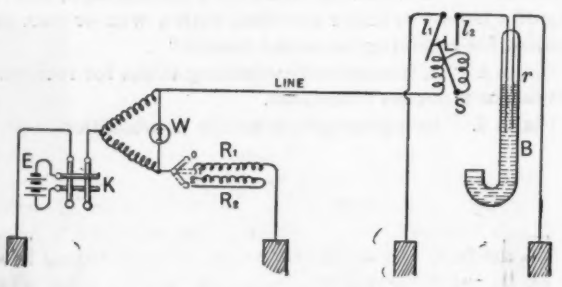
Electric, water, spring and weight motors have been devised to turn the machine, but they were all found to possess serious objections when put to practical use. The battery of the electric motor proved a source of great annoyance, to say nothing of the cost of maintaining it, which is considerable, and it is sure to fail just at the time it is most needed. Electricians who have tried to obtain power enough from a primary battery to run a machine of this description for any length of time will appreciate the difficulties in the way.

Water motors work well, and are particularly adapted to the purpose on account of the noiseless character of their operation, but the source of water supply in this case is the difficulty. For driving a machine always occupying a fixed place, convenient to water pipes, this form of motor is the best, with the possible exception of an electric motor connected with an electric light or power station. Spring and weight motors are too costly; necessitate gearing difficult to make so as to run quietly enough; are hard to regulate with the nicety required, and must be wound up frequently; all of which are serious objections. The form of motor I have found to best answer the requirements for general use is the ordinary treadle. It does not run down, requires only the simplest mechanism, does not get out of order, is available everywhere, and can be made for a small fraction of what other motors cost. The power necessary to run a graphophone amounts to only a fraction of that required for a sewing machine, and the treadle can be worked for hours without the least fatigue. I have therefore fitted the graphophones with treadle motors, and they have been found to answer very satisfactorily.

After selecting the kind of motor best suited to the machine, it became necessary to devise a governor suitable to use with it, for it is necessary, especially in recording and reproducing music, to have an absolutely uniform speed, and that all machines should be regulated to run at exactly the same velocity, so that records made on one machine can be reproduced properly on any other. This I have satisfactorily accomplished, and in the latter part of 1886 I devised the arrangement shown in Fig. 4. This consists of the graphophone instrument shown in Figs. 1 and 2 mounted on an ordinary stand similar in appearance to a sewing machine table. The belt from the treadle pulley below, passes up through the table to the governor or regulator in the back part of the case, from which a second belt drives the graphophone. The arrangements are such that about sixty strokes of the foot per minute are sufficient to drive the machine at full speed, and any increase in the rapidity of the motion of the foot or irregularity in its action has no effect upon the speed of the instrument, which always turns at the velocity to which it is adjusted.

The graphophone, as shown in the cut, is arranged for recording a conversation between two persons, the speaking tube resting on the table being used by one, the operator of the machine for instance, and the other tube hanging from the support at the left hand end of the table is used by the second person. Both terminate in a single tube which is connected with the recorder of the machine. The reproducer and its hearing tube, and also a blank record cylinder, are shown resting upon the cover at the back.

Machines of the design shown in Fig. 4 have been in operation in Washington for at least eighteen months, and they have also been exhibited successfully in other places in different parts of the country. About the first of May, 1887, one of these machines was taken to New York City by myself and a party of gentlemen, connected with the American Graphophone Company, for the express



AN ELECTRIC BAROMETER.

purpose of showing it to Mr. Edison and his associates of the Edison Speaking Phonograph Company. Upon our arrival in New York, however, we found Mr. Edison ill at his home in New Jersey, and so did not have the pleasure of showing him the graphophone; but several of his associates of the Phonograph Company inspected and tried the machine, and I think were pleased with its performance. As Mr. Edison resumed work on the phonograph about this time, and afterwards adopted the most important "essentials" of this machine, I conclude that he also was fairly well satisfied with its performance, as reported to him by his associates.

In the spring of 1887 I designed the form of graphophone shown in Figs. 5 and 6, for the purpose of getting the apparatus into a cheaper and more convenient shape to manufacture, and also to increase its efficiency and ease of manipulation. This machine is the one in practical use at the present time, and being manufactured for sale by the American Graphophone Company, which company controls the invention for the United States and Canada.

Fig. 5 shows the machine in condition for making a record, and a person in the act of dictating to the instrument. Instead of a single speaking tube and mouth-piece, as shown in the cut, a double arrangement is used when it is desired to record a conversation between two persons as stated in connection with Fig. 4. This is found very convenient for taking depositions and in similar work.

Fig. 6 shows the machine arranged for reproducing the records and making a type-writer copy. By pressing one of the small keys shown on the right of the graphophone, the reproduction of what is recorded on the wax cylinder commences, and when as many words as is desired are reproduced, a slight pressure on the second key stops the cylinder while the motion of the foot and regulator continue, and the words reproduced are printed by the type-writer. The first key is then pressed again, and a few more words of the record reproduced, which are in turn printed by the type-writer, and so on throughout the record. The capacity of a wax cylinder six inches long and one and one quarter inches in diameter when dictated to at the rate of one hundred and fifty words per minute is about seven hundred words, but if the cylinder is given the surface velocity used by Mr. Edison in the so-called improved phonograph, the capacity would be about seventeen hundred words. I have found it advantageous, however, to use a higher surface speed, as the reproduced sounds are thus made louder and clearer. The groove cut in the wax by the recording style is only three one-thousandths of an inch wide, and less than this in depth, and one hundred and sixty-one grooves to the inch are cut on the cylinder. The total length of the record on a six-inch cylinder will therefore be about two hundred and fifty feet. Cylinders two, four, and six inches long are used. The operation of changing them does not occupy five seconds, and six-inch cylinders will be sold for about three cents each, and the shorter ones in proportion.

The graphophone, as manufactured, can be converted from a single to a double machine by simply applying the extra parts for holding the second cylinder, the key connection, and an extra recorder. A few minutes only is required to make the change, and the machine then presents the appearance shown in Fig. 7. Each cylinder has a separate recorder, the two recorders being connected to one speaking-tube, and two records are made at the same time with no more effort than is required to produce one. This will be found useful for correspondence, one record being sent to the correspondent and the other retained for the copy. There are other uses to which this feature can be applied with advantage, which will readily suggest themselves to the users of the machine.

Owing to the limited facilities at my command, the work of developing the graphophone and fitting it for practical every-day use has necessarily been slow. I have not enjoyed the benefits derived from wealth and a laboratory with a hundred or more assistants; nor have I been fortunate enough to have a number of factories at my disposal in which to manufacture machines.

The commercial graphophone was completed last summer and put into the hands of the manufacturers early last fall. To manufacture apparatus of this character properly, so that the principal parts will be interchangeable, and that records made on one machine may be reproduced on any other, requires the expenditure of a great deal of labor in the preparation of the special tools, gauges, etc., necessary to do the work, and much delay has been the result. The machines are adjusted and put out as rapidly as they are received from the manufacturers, and the success of those already in practical every-day use has demonstrated their entire practicability and value as a labor-saving invention. Graphophones are used in Washington in both houses of Congress for work in connection with reporting the proceedings, and also by members for the dictation of their correspondence, etc. Many of the leading stenographers and lawyers of Washington are also using the machines, and find them of great help in their work. Thousands of record cylinders have been issued to supply these machines, and I have devised and had constructed special machines and appliances to make them cheaply and accurately. A six-inch cylinder weighs less than half an ounce, and mailing boxes have been devised weighing (including a cylinder with seven hundred words recorded upon it) about one ounce. These boxes will be sold for a small amount, and can be used a number of times, and pass through the mails for two cents at letter postage. Arrangements are in progress for manufacturing graphophones and cylinders on a large scale, and in a short time they will be turned out in sufficient quantities to supply the very active demand. I may add that full particulars in regard to the machines and cylinders can be obtained by addressing the American Graphophone Agency, 160 to 164 Broadway, New York City, where the instrument is on exhibition.

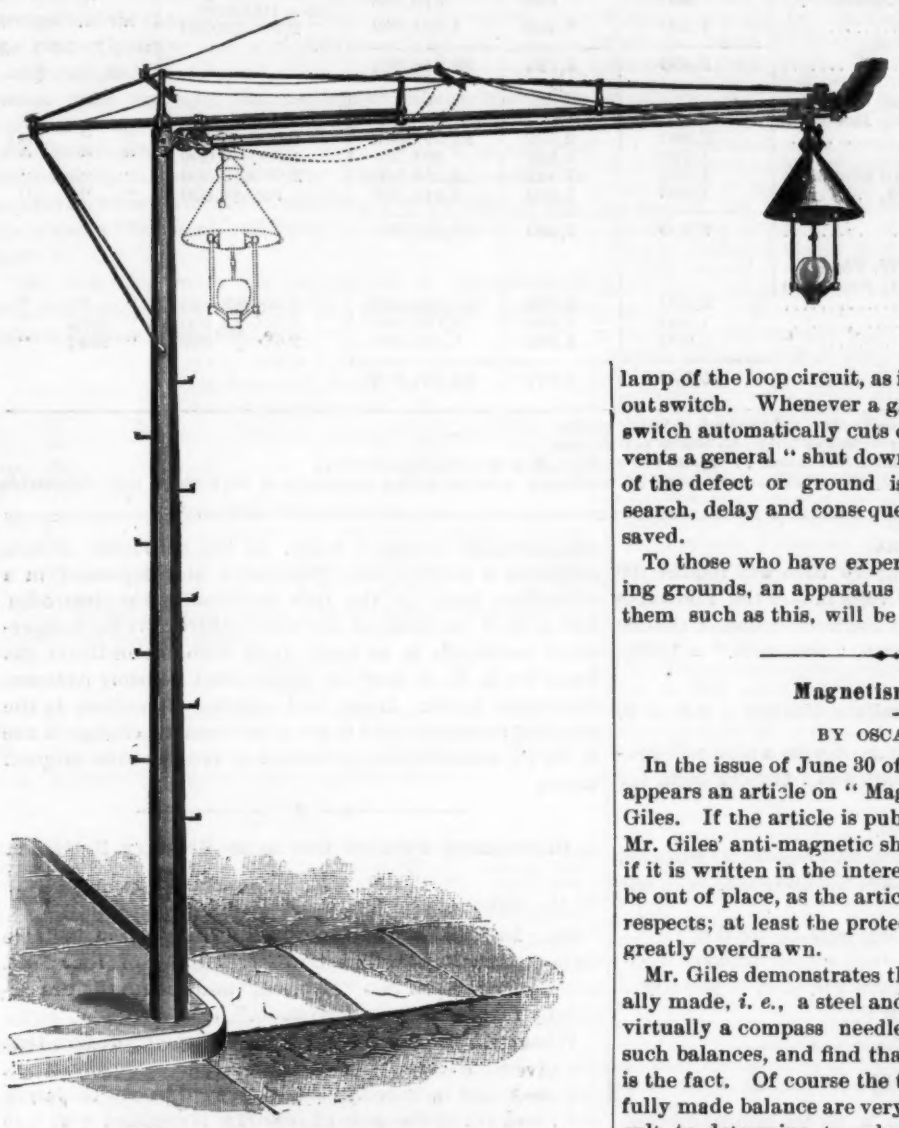
Stephen's Electrical Barometer.

The object of this apparatus is to enable the height of the barometrical column to be ascertained when the instrument is placed at a distance from an observatory. The general idea of the invention is not, we believe, novel, but the means by which it is carried out is decidedly new and ingenious. The principle of the apparatus is as follows, and is shown by the illustration taken from the London *Electrical Review*.

B is the barometer tube placed at a distance from the observatory station, and connected to the latter by a single line wire. Through the upper end of this tube the wire, or carbon filament, resistances *r* are inserted; these resistances dip down into the mercury, which short-circuits them, so that the actual portions of the wires or filaments offering resistance will obviously vary as the column of the mercury rises or falls. To determine, therefore, the height of the column, we have only to measure the resistances *r*. In actual practice these resistances would measure about 5 ohms to the inch.

So far the arrangement does not possess any distinctive feature. To measure the exact value of the resistances *r*, we must, of course, know accurately the value of the "line" resistance, as this must be deducted from the total measured resistance, in order to determine the value of *r*. Now if the line resistance were a constant quantity, there would be no difficulty in determining *r* by a single measurement; but, of course, as is well known, the line resistance constantly varies, and it is the getting over of this point that constitutes the special feature of Mr. Stephen's invention. Connected in circuit with the line is a special form of automatic switch *S*. This switch enables the line current to be diverted at the receiving end of the line from one circuit to another, as required, by causing the line current to pass in one direction or the

other. The line current, it will be seen, passes through the magnet coils of the switch, and thence through a polarized armature, and then from the end of this armature to one or other of the two levers l_1 l_2, according as the lever is over to the left or right; to effect which result the arrangement is such that contact is not broken from one lever until it is made with the other, so that the continuity of the line remains unbroken. The lever



A NEW ARC LIGHT MAST ARM.

l_2 is connected to the barometer resistances, and the lever l_1 to earth direct.

At the observatory station a Wheatstone bridge W is arranged with a double key K. The adjustable resistance of the bridge is in two parts R_1 and R_2. At W there is a three point switch; in position 0 this switch is disconnected; in position 1 it is connected to resistance R_1, and in position 2 to resistance R_2.

The working of the whole arrangement is as follows: The switch being in position 0, the left hand pedal of the key K is depressed; this sends a current from the battery E direct to line, and actuates the switch S, so that its armature moves over to the lever l_1, putting the line direct to earth through the coils of the switch. The hand switch is then moved over to position 1, and balance is obtained on the galvanometer by adjusting R_1; this resistance then will be the resistance of the line wire and the coils of the switch S. The switch is then moved back to 0, and the right hand pedal of the key K is depressed. This causes a current to be sent, which moves the armature of S over to l_2, thus putting the resistance r in circuit. Switch s is now moved to 2, and the balance is obtained by adjusting R_2. Since R_1 is still in circuit it is obvious that the resistance R_2 must be the resistance of r, hence we get the value of r quite independent of the value of the line resistance.

It is obvious that the whole arrangement is adaptable not only for the measurement of the height of a barometric column, but for thermometers as well, and indeed for several other purposes.

A New Electric Light Mast Arm.

Our illustration represents a mast arm for the support of arc lamps, recently designed by Mr. Jas. J. Renehan, of New Britain, Conn., and which possesses some novel features. As will be seen, the top of the lamp is fastened to an endless rope which passes over a pulley at the post and to which a crank is attached. By turning the crank, the endless rope is set in motion and the lamp drawn in, so as to be within convenient reach of the trimmer. By turning the crank in the opposite direction, the lamp is brought back to its proper position at the end of the arm.

The arm is built of 1¼-inch wrought-iron pipe, and of castings which are held in place by means of set screws A simple arrangement is employed for taking the slack. out of the endless rope, so that the lamp is firmly held in position.

A New Automatic Ground Switch.

The inconvenience and loss caused by the necessity of shutting down lighting circuits when grounds are developed, and the time lost in hunting such grounds makes some device by which these may be avoided of interest. For this purpose the Electrical Supply Company, of Chicago, have just brought out a novel automatic ground switch, which is shown in front and rear views in the accompanying engravings, Figs. 1 and 2.

The switch is designed particularly to be used in connection with loops which are specially liable to develop grounds, such as in the case of wires leading to lamps or motors within buildings. Wherever a loop is required, the main line is led into the automatic switch; the wire then leads from the switch to the first and last lamp of the loop circuit, as in the case of any ordinary cut-out switch. Whenever a ground occurs upon this loop the switch automatically cuts off the grounded loop, and prevents a general "shut down" of the circuit. The location of the defect or ground is thus pointed out, and a long search, delay and consequent loss of rental are thereby saved.

To those who have experienced the vexations of hunting grounds, an apparatus which gives a strong clue to them such as this, will be very welcome.

Magnetism in Watches.

BY OSCAR ERICSSON.

In the issue of June 30 of THE ELECTRICAL WORLD there appears an article on "Magnetism in Watches," by C. K. Giles. If the article is published as an advertisement for Mr. Giles' anti-magnetic shield cases, it is very good; but if it is written in the interest of science, criticism will not be out of place, as the article seems exaggerated in several respects; at least the protection afforded by the shield is greatly overdrawn.

Mr. Giles demonstrates that a balance wheel, as generally made, *i. e.*, a steel and brass compensated balance, is virtually a compass needle. I have tested a number of such balances, and find that in the majority of cases such is the fact. Of course the traces of magnetism in a carefully made balance are very slight, so that it becomes difficult to determine to what extent this cause alone will affect a watch exposed to no other magnetic influence except that the earth has on the compass needle, or, in this case, the balance wheel of the watch.

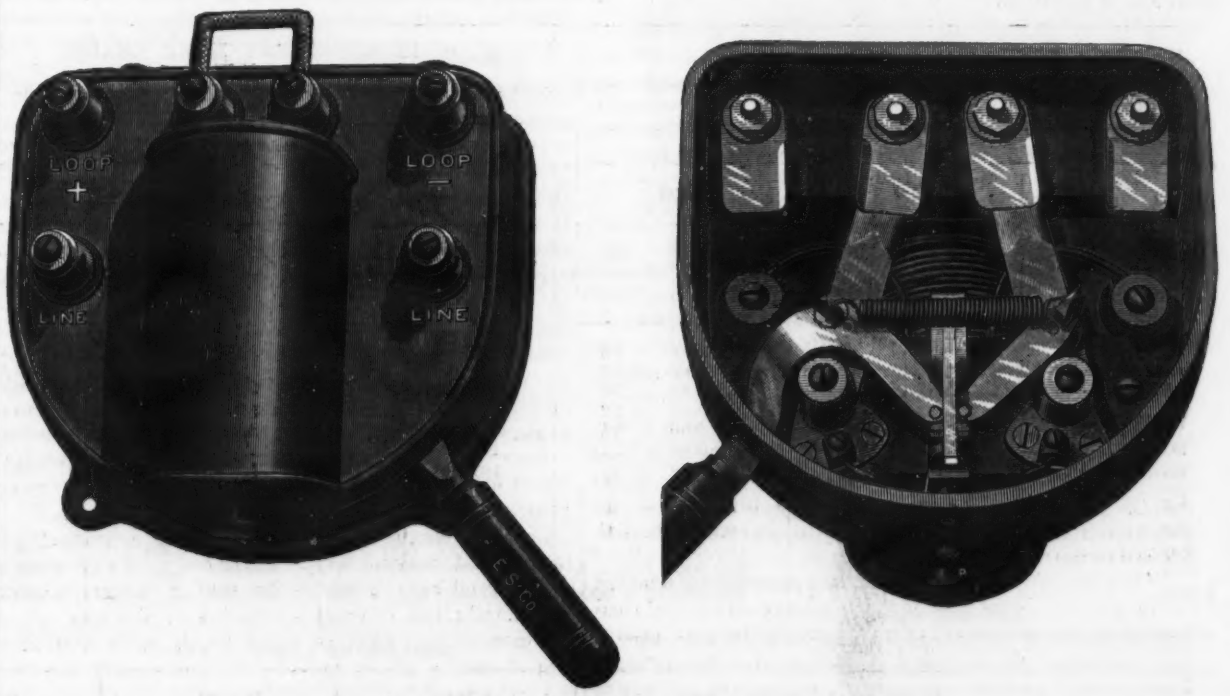
But I believe it is safe to assume that the effect will be directly proportional to the strength of the magnetism in the balance wheel. Then let us replace the balance wheel with a bar of steel strongly magnetized. Now let us put the watch in a shield case and let it run, say 24 hours, in a certain position and note its rate. Then let us change its position and let it run another 24 hours. Now if the "rate" will be the same with the watch placed in a different position, it follows that the shield is an absolute protection against magnetic influence.

If, on the contrary, the "rate" varies with the different positions of the watch, as you will find it does, then the shield is not efficient or, at least, is only a partial protection.

Another test less troublesome to make is this: Take a shield case and place a compass instead of a watch within it, and move a magnet around the shield and you will see the needle respond to the motion of the magnet.

I have experimented considerably with the shield case, and every experiment has led to the conclusion that no watch whose escapement, balance wheel or hairspring is made of magnetic metal can be depended on when exposed in the pockets of persons having business around powerful continuous current dynamos.

What degree of perfection has been attained in watches made of non-magnetic metal I am not prepared to state at present. But I have decided to discard the shield and begin observation and experiment with a non-magnetic watch, and if I find my observations sufficiently interesting I shall touch on the subject again.



FIGS. 1 AND 2.—ELECTRIC LIGHT GROUND SWITCH.

The Relative Merits of Iron and Lead Covering for Cables.

BY DAVID BROOKS.

Among the advantages of iron over lead, beside cheapness and greater strength, wrought iron is free from pores. In coiling and uncoiling lead you are liable to open pores. As lead tubing is coiled, the outer surface of the tube forming the circle is elongated and the inner surface compressed, and this condition is produced by the comparatively rigid nature of the cable or conductors inside. If the insulation consists of paraffine, which is all broken up by the coiling, the moisture goes directly to the conductors. If it goes to the mixture of rosin and rosin oil it stops there, provided it does not reach the textile covering. In that case it finally penetrates the covering and reduces the insulation. Wire after wire will fail. Wrought-iron pipe is rigid and has no pores, that being proved under a pressure of from one thousand to two thousand pounds to the square inch. The socket joints are rendered moisture proof by the use of a cement of white lead and linseed oil; but supposing the socket-joints are not perfectly moisture proof, the insulating material is poured directly into the socket at a temperature of 400 degrees Fahr. and fills all apertures. On cooling it will remain and prevent all ingress of moisture. When lead is drawn over a cable the textile covering comes directly in contact with the lead and the pores opened in the lead admit moisture to the textile covering. Thereby insulation fails. In iron pipe the position of the cable is shown by two circles, the outer circle representing the pipe, the inner circle that of the cable. The space between the two circles is filled with the insulating mixture, which is heavier than water and does not crack or check, being semi-fluid at a temperature below freezing. It will be seen that the chance of moisture reaching the cable is exceedingly remote. Lead encased cables are very little used in this country except for telephonic purposes, and then for short distances, seldom over a mile. Telephones can be worked for that distance with very low insulation. To remedy the difficulty—porosity of the lead—they are sometimes laid in a trough and covered with pitch. Felten & Guilleaume cover the cable with a braid saturated with bitumen. Berthoud-Borel draw on one covering of lead and cover that with an insulating material, and over that draw a second lead covering.

As to comparative cost, a lead cable one inch inside diameter, of the weight usually used in this country, costs twelve cents per foot or upwards. An iron pipe, lap-welded, two and a half inches diameter, suitable for the purpose, can be had at twelve cents per foot. The capacity of the iron pipe is over six times that of the lead, and it can be made to contain six times as many conductors with the same amount of covering or insulation, or we can give the conductors six times the insulation and less than one-sixth the electro-static capacity. It is a very easy matter to make an

electric light conductor show an insulation of from five thousand to twenty thousand megohms per mile and at trifling expense as compared with ordinary modes of insulation.

The cable that I laid a year ago of this new system shows higher insulation at this time than when first laid. I can say at even temperature it is more than twice as high. It does not cost over one-quarter that of the cheapest of other systems. The insulation is protected by wrought iron. The outer surface of the pipe is protected from oxidation by a coating of pitch or asphalt.

The method of laying it is so simple that any person can do it without previous experience, it being only necessary to strictly follow the printed directions.

Proposed Trans-Pacific Cables.

Great interest is felt here and in England in the proposed cables to cross the Pacific between America and Asia. We are glad to be able to give above a table which we believe to represent fairly the various items connected with the three leading plans now before the public.

PROPOSED TRANS-PACIFIC SUBMARINE ROUTES.

Landing places.	Distances. Nautical miles.	Length of cable.	Estimated cost @ $700 per mile laid.	Average soundings in fathoms.	Nature of ocean bed,
Route projected by F. N. Gisborne, C. E. and Electrician.					
Vancouver Island, B. Columbia, to Unimak, Aleutian Islands	1,350	1,485	$1,039,500	2,000@2,800	ooze, mud & sand
Unimak to Alton Island, Aleutian Islands	800	880	616,000	Not sounded, probably 100@200	" "
Alton Island to Yezzo, Japan	1,300	1,430	1,001,000	2,700@3,000	" "
Totals	3,450	3,795	$2,656,500		
Route projected by S. Fleming, C. E.					
Vancouver Island, B. Columbia, to Honolulu, Sandwich Islands	2,300	2,530	$1,771,000	2,000@3,100	" " "
Honolulu to Fanning Island	1,040	1,145	801,500	1,300@3,000	" " clay
Fanning Island to Vanua Lavis, Fiji Islands	1,674	1,841	1,288,700	2,000@3,300	" " "
Vanua Lavis to Brisbane, Australia	1,486	1,634	1,143,800	930@2,600	" " "
Totals	6,500	7,150	$5,005,000		
Route projected by Mr. Cyrus W. Field, San Francisco, Cal., to Honolulu, Sandwich Islands	2,070	2,277	$1,593,500	2,000@3,120	" " "
Honolulu to Morrell Island	1,500	1,650	1,155,000	1,500@3,100	" lava "
Morrell Island to Nipon, Japan	1,800	1,980	1,386,000	2,700@ 300	" mud "
Totals	5,370	5,907	$4,134,500		

N. B. Actual rate of working speeds attained through existing cables:
French Atlantic, Brest to St. Pierre, 2,584 miles, 15 words per minute.
Anglo-American Cables, 1,896 and 1,857 miles, 17 words per minute, May 25, experimentally.
The estimated speed of a cable of 1,500 nautical miles being 33 words per minute, with a maximum of the highest rate obtainable by an operator.

A Table of Incandescent Lamp Leads.

The accompanying table is based on Matthiessen's determination that the resistance between opposite faces of a centimeter cube of pure annealed copper at 0° C. is 1.598 legal microhms; it is calculated for 98 per cent. copper at 75° F., from the formula:

$$d^2 = \frac{20\,D\,C}{P}$$

Where d = diameter of wire in mils.
" D = distance of lamps in feet.
" C = total current in legal ampères.
" P = allowable fall of potential in legal volts.

TO USE THE TABLE.

Find the required current in the first column marked "ampères," and follow the horizontal line to its intersection with the column giving the required distance of the lamps, and divide the number at this intersection, under the head of "circular mils," by the allowable loss of potential expressed in volts. The quotient will be the d^2 of the required wire, and the corresponding number of the wire, in any gauge, may be found by reference to the ordinary wire gauge tables.

For all round numbers from 1 to 1,000 ampères, and 10 to 10,000 feet, at 1 per cent. drop, the size of the wire, in American gauge, is given directly by the table. Where greater accuracy is required, the values of d^2 for intermediate currents and distances are separately determined, as above, and then added together, their sum being the d^2 of the required wire.

EXAMPLES.

(1). It is required to find the size of wire which will convey current to 200 100-volt ½ ampère lamps, located at a distance of 500 feet from the source of current, at 5 per cent. loss of potential.

METHOD.

Two hundred lamps of ½ ampère each will require 100 ampères, and 5 per cent. of 100 volts makes the allowable loss of potential five volts. At the intersection of the 100 ampère line, and 500 feet column, "circ. mils." = 1,000,000.

$\therefore d^2 = \frac{1000000}{5} = 200{,}000$ cir. mils = No. 000 + 5 B. & S.

(2). It is required to find the size of wire which will convey current to 50 lamps of 50 volts and 1 ampère each, for 150 feet, at 2 per cent. drop.

METHOD.

Fifty lamps of 1 ampère each will require 50 ampères and 2 per cent. of fifty volts makes the allowable drop one volt.

50 ampères at 100 feet gives circ. mils. = 100,000.
50 " " 50 " " " " = 50,000.
$\therefore d^2$ = 100,000 + 50,000 = 150,000 cir. mils = No. 000 + No. 8 B & S.

A New Constant Cell.

MM. Fabingi and Farkas, in a recent communication made to the French Académie des Sciences, described a new constant cell devised by them. It consists of a small platinum vessel coated on the inside with a compound having the empirical composition $Na_2H_{12}Pt_2O_{11}$, and which is formed by heating the platinum in contact with caustic soda. The vessel is filled with fused caustic soda maintained in a fluid condition by means of a small gas jet. The positive electrode consists of platinum, the negative one of gas carbon. On closing the circuit the E. M. F. soon assumes a steady value, as the carbonate of soda produced is continuously eliminated and deposited in a crystalline form on the free surfaces of the electrodes The E. M. F. depends on the temperature, but the temperature coefficient is so small that with an ordinary gas flame the E. M. F. may be maintained sensibly constant for several hours. Large and sudden alterations in the external resistance only cause a momentary change in the E. M. F., which almost immediately returns to its original value.

A Discrepancy Pointed Out as to Primary Batteries.

To the Editor of The Electrical World:

SIR: In your issue of June 16th there is given in table form the results of a trial by Prof. Dolbear of four cells, two Leclanché and two "Samson," and the results are decidedly favorable to the "Samson."

What puzzles me is the remark of the Professor, that one of the "Samson" cells was smaller than the other, and could not be expected to give the current of the larger one; and yet in the table of results it is credited with 1.16 ampère, and the larger one with 1.11 ampère.

Taking the figures as they are given as the result of trial on short circuit of 30 minutes, I cannot see any marked superiority of the "Samson" over the Leclanché, and feel quite confident that had the trial continued to one hour the superiority of the "Samson" would have been still less apparent. My attention, however, was specially arrested by the figures above named. B. J. W.

NEW YORK CITY.

TABLE OF INCANDESCENT LAMP LEADS.

SHOWING SIZES OF WIRE REQUIRED TO CARRY FROM 1 TO 1,000 AMPÈRES FROM 10 TO 10,000 FEET, AT 1 VOLT FALL OF POTENTIAL.

By G. B. Prescott, Jr. *Copyrighted 1888, by Holmes, Booth & Haydens.*

DISTANCE OF LAMPS IN FEET.

Total Current. Ampères.	10		20		30		50		100		200		300	
	d^2 Circ. Mils.	No. American Gauge.	d^2 Circ. Mils.	No. American Gauge.	d^2 Circ. Mils.	No. American Gauge.	d^2 Circ. Mils.	No. American Gauge.	d^2 Circ. Mils.	No. American Gauge.	d^2 Circ. Mils.	No. American Gauge.	d^2 Circ. Mils.	No. American Gauge.
1	200	27	400	24	600	22	1,000	20	2,000	17	4,000	14	6,000	12
2	400	24	800	21	1,200	19	2,000	17	4,000	14	8,000	11	12,000	9
3	600	22	1,200	19	1,800	17	3,000	15	6,000	12	12,000	9	18,000	7
5	1,000	20	2,000	17	3,000	15	5,000	..	10,000	10	20,000	7	30,000	5
10	2,000	17	4,000	14	6,000	12	10,000	10	20,000	7	40,000	4	60,000	2
20	4,000	14	8,000	11	12,000	9	20,000	7	40,000	4	80,000	1	120,000	0 + 9
30	6,000	12	12,000	9	18,000	7	30,000	5	60,000	2	120,000	0 + 9	180,000	000 + 9
50	10,000	10	20,000	7	30,000	5	50,000	3	100,000	0	200,000	000 + 5	300,000	0000 + 1
100	20,000	7	40,000	4	60,000	2	100,000	0	200,000	000 + 5	400,000	$\overline{0000}^2$	600,000	$\overline{0000}^2$ + 000
200	40,000	4	80,000	1	120,000	0 + 9	200,000	000 + 5	400,000	$\overline{0000}^3$	800,000	$\overline{0000}^3$ + 000	1,200,000	$\overline{0000}^5$ + 00
300	60,000	2	120,000	0 + 9	180,000	000 + 9	300,000	0000 + 1	600,000	$\overline{0000}^3$ + 000	1,200,000	$\overline{0000}^5$ + 00	1,800,000	$\overline{0000}^8$ + 0
500	100,000	0	200,000	000 + 5	300,000	0000 + 1	500,000	$\overline{0000}^2$ + 1	1,000,000	$\overline{0000}^4$ + 000	2,000,000	$\overline{0000}^5$ + 0	3,000,000	.....
1,000	200,000	000 + 5	400,000	2 + 0000	600,000	$\overline{0000}^2$ + 000	1,000,000	$\overline{0000}^3$ + 000	2,000,000	$\overline{0000}^5$ + 0	4,000,000	.....	6,000,000	.....

DISTANCE OF LAMPS IN FEET.

Total Current. Ampères.	500		1,000		2,000		3,000		5,000		10,000	
	d^2 Circ. mils.	No. American gauge.	d^2 Circ. mils.	No. American gauge.	d^2 Circ. mils	No. American gauge.	d^2 Circ. mils.	No. American gauge.	d^2 Circ. mils.	No. American gauge.	d^2 Circ. mils.	No. American gauge.
1	10,000	10	20,000	7	40,000	4	60,000	2	100,000	0	200,000	000 + 5
2	20,000	7	40,000	4	80,000	1	120,000	0 + 9	200,000	000 + 5	400,000	$\overline{0000}^2$
3	30,000	5	60,000	2	120,000	0 + 9	180,000	000 + 9	300,000	0000 + 1	600,000	$\overline{0000}^2$ + 000
5	50,000	3	100,000	0	200,000	000 + 5	300,000	0000 + 1	500,000	$\overline{0000}^2$ + 1	1,000,000	$\overline{0000}^3$ + 000
10	100,000	0	200,000	000 + 5	400,000	$\overline{0000}^2$	600,000	$\overline{0000}^2$ + 000	1,000,000	$\overline{0000}^3$ + 000	2,000,000	$\overline{0000}^5$ + 0
20	200,000	000 + 5	400,000	$\overline{0000}^2$	800,000	$\overline{0000}^3$ + 000	1,200,000	$\overline{0000}^3$ + 00	2,000,000	$\overline{0000}^5$ + 0	4,000,000	.....
30	300,000	0000 + 1	600,000	$\overline{0000}^2$ + 000	1,200,000	$\overline{0000}^5$ + 00	1,800,000	$\overline{0000}^5$ + 0	3,000,000	.....	6,000,000	.....
50	500,000	$\overline{0000}^2$ + 1	1,000,000	$\overline{0000}^3$ + 000	2,000,000	$\overline{0000}^5$ + 0	3,000,000	.....	5,000,000	.....	10,000,000	.....
100	1,000,000	$\overline{0000}^3$ + 000	2,000,000	$\overline{0000}^5$ + 0	4,000,000	.....	6,000,000	.....	10,000,000	.....	20,000,000	.....
200	2,000,000	$\overline{0000}^5$ + 0	4,000,000	.....	8,000,000	.....	12,000,000	.....	20,000,000	.....	40,000,000	.....
300	3,000,000	.....	6,000,000	.....	12,000,000	.....	18,000,000	.....	30,000,000	.....	60,000,000	.....
500	5,000,000	.....	10,000,000	.....	20,000,000	.....	30,000,000	.....	50,000,000	.....	100,000,000	.....
1,000	10,000,000	.....	20,000,000	.....	40,000,000	.....	60,000,000	.....	100,000,000	.....	200,000,000	.....

"Effects of Different Positive Metals, etc., upon the Changes of Potential of Voltaic Couples."*

BY D. G. GORE, F.R.S.

In this research, numerous measurements were made, and are given in a series of tables of the effects upon the minimum point of change of potential of a voltaic couple in distilled water (Roy. Soc. Proc., June 14, 1888), and upon the changes of electromotive force attending variation of strength of its exciting liquid (Ibid.) obtained by varying the kind of positive and of negative metal of the couple, and by employing different galvanometers. The measurements were made by the method of balance through a galvanometer, with the aid of a suitable thermo-electric pile (Birmingham Philos. Soc. Proc., Vol. 4, p. 130; the *Electrician*, vol. ii., p. 414). The kinds of galvanometer employed were an ordinary astatic one of 100 ohms resistance, and a Thomson's reflecting one of 3,040 ohms resistance.

The following were the proportions of hydrochloric acid (HCl) required to change the potential of different voltaic couples in water :

TABLE 1.

Hydrochloric Acid.

Astatic galvanometer.

Zn + Pt	Between	1 in	9,300,000	and	9,388,185
Cd + Pt	"	1 "	574,000	"	637,000
Mg + Pt	"	1 "	516,666	"	574,000
Al + Pt	"	1 "	12,109	"	15,000

Reflecting galvanometer.

Zn + Pt	Between	1 in	15,500,000	and	23,250,000
Cd + Pt	"	1 "	1,162,500	"	1,550,000
Mg + Pt	"	1 "	775,000	"	930,000
Al + Pt	"	1 "	42,568	"	46,500

With iodine and the astatic galvanometer the following proportions were required :

TABLE 2.

Iodine.

Zn + Pt	Between	1 in	3,100,000	and	3,521,970
Mg + Pt	"	1 "	577,711	"	643,153
Cd + Pt	"	1 "	200,431	"	224,637

With bromine and the astatic galvanometer :

TABLE 3.

Bromine.

Mg + Pt	Between	1 in	310,000,000	and	344,444,444
Zn + Pt	"	1 "	77,500,000	"	84,545,000
Cd + Pt	"	1 "	3,470,112	"	3,875,000

The magnitudes of the minimum proportions of bromine required to change the potentials of the three couples in water varied directly as the atomic weights of the three positive metals.

With chlorine, the following were the minimum proportions required :

TABLE 4.

Chlorine.

With the reflecting galvanometer.

Mg + Pt	Between	1 in	27,062,000,000	and	32,291,000,000

With the astatic galvanometer.

Mg + Pt	Between	1 in	17,000,000,000	and	17,612,000,000
Zn + Pt	"	1 "	1,264,000,000	"	1,300,000,000
Zn + Au	"	1 "	518,587,360	"	550,513,022
Cd + Pt	"	1 "	8,733,585	"	9,270,833
Zn + Cd	"	1 "	55,436	"	76,467

In the case of chlorine, as well as that of bromine, the magnitudes of the minimum proportions of substance required to change the potential of magnesium-platinum, zinc-platinum, and cadmium-platinum, varied directly as the atomic weights of the positive metals.

The examples contained in the paper show that the proportion of the same exciting liquid necessary to disturb the potential of a voltaic couple in water varied with each different positive or negative metal, and that the more positive or more easily corroded the positive metal, or the more negative and less easily corroded the negative one, the smaller usually was the minimum proportion of dissolved substance necessary to change the potential.

By plotting the results in all cases, it was found that the order of change of potential, caused by uniform change of strength of liquid, varied with each positive metal.

The results also show that the degree of sensitiveness of the arrangement for detecting the minimum point of change of potential, depends largely upon the kind of galvanometer employed.

As a more sensitive galvanometer enables us to detect a change of potential caused by a much smaller proportion of material, and as the proportion of substance capable of detection is smaller, the greater the free chemical energy of each of the uniting bodies (Roy. Soc. Proc., June 14, 1888), it is probable that the electromotive force really begins to change with the very smallest addition of the substance, and might be detected if our means of detection were sufficiently sensitive or the free chemical energy of the uniting bodies was sufficiently strong.

*Read before the Royal Society, June 21, 1888. Abstract.

On Some Possible Methods for the Preparation of Gramophone and Telephone Records.†

BY PROF. EDWIN J. HOUSTON.

Phonograph records, of the type employed by Mr. Berliner in his gramophone, *i. e.*, those obtained by causing the point or stylus attached to the vibrating diaphragm to move parallel to the recording-surface instead of perpendicular thereto, can be prepared more readily, and by a greater variety of methods, than is possible with record-surfaces of the old forms.

In a study of the later forms of phonographic apparatus, several methods of preparing gramophone plates have suggested themselves to the author, which he hopes soon to be able to put to the test of actual trial. These methods, though particularly applicable to records horizontally traced, may, in certain cases, by slight modifications, be applied also to those vertically traced.

In order to place some of these methods on record, a brief description will be given of a few of the most promising. At the same time, the author admits that serious difficulties may lie in the way of practically carrying out some of the methods proposed.

Mr. Berliner, as is well known, prepares his record surfaces by moving the tracing point over the surface of a plate of inked glass or metal, covered with a uniform deposit of lamp-black. The record thus obtained is either mechanically copied on a metal surface, or is reproduced thereon by the process of photo-engraving or etching. I would suggest the following methods, viz.:

(1.) After the record on smoked glass is obtained in the usual manner, expose the plate to the action of a regulated sand-blast so as to obtain cuttings or groovings on the surface of the plate, suitable for the movements of the reproducing diaphragm. Roughness in the edges of the lines so obtained would probably cause screaming sounds in the words reproduced, which might be removed by a few applications of an emery-covered tracing point.

(2.) The phonogram record surface is composed of a smooth surface of hardened wax, on a composition of wax and resin which is *locally heated* so as to *slightly soften the surface* directly under the tracing point or stylus.

In order to insure the rapid cooling and hardening of the surface, immediately after the impression has been impressed thereon, the heating must be local and not general. To more thoroughly insure local cooling, a light blast of cool air might be directed on the surface almost immediately after the tracing has been made.

(3.) Instead of heating the record surface itself, a local source of heat may be used to heat the tracing point or stylus. This heat may be either ordinary heat or that of electrical origin. When the stylus, instead of the record-surface, is heated, the latter may be made of much harder material,

(4.) The record-surface consists of a glass plate covered with a thin layer of wax. Either the record-surface itself, or the marking stylus, is locally heated as before, only the layer of wax is so thin as to leave the glass exposed after the passage of the tracing-point. A permanent record is then etched in the surface of the plate so prepared either by the sand-blast process, or, preferably, by the action of hydro-fluoric acid.

(5.) Instead of employing the records of the lamp-blackened glass surface as a photographic negative for the purpose of reproducing them by photo-engraving or etching, they may be used for transferring the record to a glass surface covered with a film of sensitized gelatine. The portions of the glass that are left uncovered after the plate is fixed are then deeply cut or etched by treatment with either gaseous or diluted liquid hydro-fluoric acid. I have treated a gelatine-covered glass plate printed from a photograph by means of this process, and find that it produces a very fair and permanent picture on the glass. It is evident that this process will leave the design either in relief or intaglio, according as a photographic negative or positive is used.

(6.) The recording diaphragm, in its movements to and fro, is caused to deposit on the surface of the record-plate a uniformly thick line or layer of some rapidly hardening substance. This substance is contained in a vessel provided with a pointed outlet tube, and attached to the diaphragm. The material either runs out by its weight and is deposited on the record surface, or is forced out by the movements of the diaphragm itself. A record, thus prepared, would consist of a uniformly thick, sinuous ridge of the hardened material. The reproducing stylus, or that giving motion to the diaphragm that reproduces the speech, could, it is evident, be operated either from the upper or lower surfaces of the sinuous ridge independently, or from both simultaneously.

(7.) If the movements of the receiving diaphragm of a telephone be sufficiently amplified or intensified to permit it to trace or cut a sinuous record on a suitably prepared record surface by any of the methods proposed in this article, or by any other method, then there would be produced a simple, yet effective method for obtaining not only a permanent record of a telephone dispatch, but as well a means of reproducing it as often as might be desired.

It should be carefully borne in mind that a telephone record may be made of very small dimensions. Indeed, in the case of any phonograpic apparatus, where it is not intended that the record should reproduce the sounds by direct mechanical movements of the diaphragm large records are not always necessary nor are they desirable ; for such reproduction may be effected electrically.

Where the telephone record-surface has been prepared, no effort should be made to cause it to reproduce the telephonic despatch mechanically. *An electrical method of reproduction is far the preferable one.*

(8.) The following method would appear to promise excellent results. Employ the telephone record to act mechanically on a lever or other device, but instead of attempting to cause the movements of such a lever to impart audible, articulate motion to a receiving diaphragm, cause them to act directly on a variable resistance, in the circuit of which is included a voltaic battery and a receiving telephone. Since, for such an operation, very slight movements of the variable resistance contacts are required, it is by no means improbable that some of the methods proposed, or obvious modifications thereof, will, in practice, be found applicable to the production of a permanent telephone record.

(9.) Before concluding this brief sketch, it might be well to suggest the following plan, which would appear to be particularly suitable for obtaining a telephone record: Mount a concave mirror at the centre of the diaphragm of the receiving telephone; or, better yet, from the entire diaphragm of a concave mirror, shaping the magnet pole of the telephone to conform to the approximated surface thereof. When the telephone is receiving transmitted speech, allow the light reflected from the diaphragm-mirror, and suitably concentrated by a lens, to fall on a sensitized photographic plate placed in a plane at right angles to the plane of the diaphragm, so as to receive the spot of light parallel to its surface. The photographic plate must, of course, be moved mechanically at right angles to the direction of movement of the spot of light. The plate thus acted on is then developed, fixed, and used to reproduce the record by any of the well-known methods of photo-engraving, etching, etc. The record thus obtained may be used either mechanically to reproduce the transmitted speech in an ordinary phonographic apparatus, or, preferably, in connection with a variable resistance contact, electrically in a receiving telephone.

There can be no doubt, whatever, that this method will be found operative in practice, since the engraving stylus, a pencil of light, is destitute of weight, and therefore offers no resistance to the free movements of the telephone diaphragm.

(10.) Instead of causing the voice, as in the ordinary form of phonographic or gramophonic apparatus, to act mechanically on the record-surface, cause it to move a suitably focussed pencil of light over the surface of a photographic plate. A very complete record could thus be obtained, in which it would be possible to impress on the plate all the minute peculiarities of the overtones, on which the quality of the voice depends. In this manner there could be obtained and preserved records of the voice of distinguished individuals.

The photographic method just described would possess, among others, the following advantages, viz.:

1. The ease with which it could accurately reproduce in all their minutiæ the tones involved in the production of articulate speech.

2. The readiness with which such a record could be magnified to any desired extent, thus rendering possible an increase in the amplitude of the reproduced vibration.

3. The aid such magnified, accurate sound-records would afford in the study of the same with a view, not only of ascertaining their peculiarities, but even with a view of being able to read articulate speech directly from the diaphragm record.

†Abstract of a paper read before the American Philosophical Society, April 20, 1888.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
168-177 POTTER BUILDING, NEW YORK, July 9, 1888.

Alternating Currents in New York.

The alternating current fight now centres here. A special hearing was to have been held on Monday last, before the Board of Electrical Control, on permitting the use of alternating currents in New York, but owing to the death of a daughter of Commissioner Moss, the meeting was postponed until Wednesday. Among those in attendance from out of town were Messrs. S. C. Peck, of Boston, and T. Carpenter Smith, of Philadelphia, to argue for the new system.

The Subway Fight.

There is music in the air because there is no music in the subways. The fight between the Board of Electrical Control and the United States Illuminating Company has reached an extreme point, and the lineman's life is not a happy one should he try to do any work around the wires that the Board has condemned. The Board has not only characterized the conduct of the company as being altogether bad, but has practically handed it and its force over to the custody of the police, while the company, rather than submit to terms that it considers unjust, and accept conditions that it regards as outrageous, has allowed a number of its lights to remain unlit. President Lynch says: "The fact is that if we are compelled to put our wires in the subway we are effectually ordered to discontinue business. The subways are not yet perfected for our service. There is not a foot of electric light wire in any of them in the city. There is nothing in them but through trunk wires of telephone or telegraph companies. If our wires had to be put in them, they might as well be in Jersey City, for all the good we could get out of them. There are no facilities for connections with them. The commission will neither let us make connections at the manholes on the street corners, in which case we would have to stretch the wires overhead between the corners, nor will they let us tap the conduits anywhere else along the route. What in the name of common sense they expect us to do, is one of the things no fellow can comprehend. One member of the commission told me that facilities would be provided, but the plan had not yet been perfected. So the matter stands. Another thing, the subways are admittedly damp; some of them are as wet as sewers. An electric light wire cannot be run in a damp conduit. The rental that they want to charge us for these subways is outrageous. Each company with one duct is charged $1,000 per mile per year. The whole cost of construction of the conduit was only about $4,000 per mile. I claim that the United States system is the best in the world, and I do not hesitate to say that our line on Third avenue is the best in the world; the Sixth avenue line is next best, and the Broadway line as good as it can be made. We take all possible precautions for safety. The charges that we have 500 dead wires are absurd; I have complaints of dead wires by the score which do not belong to us at all." Mayor Hewitt has expressed his opinion that nothing can be done effectively until a decision is reached in the pending action brought by the Corporation Counsel, nor until the companies have been provided with means for local distribution of their wires.

Sprague Motors in New York.

A very significant expression of opinion as to the desirability of the electric motor has just been given by the well-known firm of Thurber, Wyland & Co. That firm learning that another large house was debating whether to put in the motor or the steam-engine, went to the trouble of writing to the firm and advising it strongly to try the Sprague motor, which they themselves found to be far better than the steam-engine for their printing office. To use their own language, "It is simpler, more efficient, needs no repairs, as there are all the time on the steam-engine, does not heat up the building, requires no engineer with a certificate, and is more economical. It does not affect the insurance, and the underwriters give permits for it. If you will investigate the experience of others who are using the motors, I think you will not consider putting in a steam-engine." This letter is signed by no less a personage than Mr. F. B. Thurber himself.

Tools for Electricians.

The machinery warerooms of E. P. Bullard, located at 62 College Place and 72 Warren street, are now filled with a large assortment of lathes, planers, drills, milling machines, turret head lathes, etc. Mr. Bullard manufactures at his factory, which

is called the Bridgeport Machine Tool Works, of Bridgeport, Conn., a fine line of machines, made especially for that class of work, requiring accuracy, solidity and power. The Edison Machine Works, Edison Phonograph Works, Thomson-Houston, Daft, Westinghouse, Mather, United States and Brush are among those who have his tools in use and speak well of them. Mr. Bullard has always at his store a full line of all kinds of machinery, and is in the market to trade if desired, thus replacing old machines by his newest and latest patterns. He also keeps a sample line of Brown & Sharpe Manufacturing Company's universal milling machines, universal grinders, etc., and as he is their accredited agent, he can furnish anything of their make at manufacturer's prices. A full line of Jones & Laughlin's cold rolled shafting, with a full line of hangers and pulleys is kept in stock, and can be delivered at short notice. Anything in the line of machinery can be had from his establishment at reasonable rates, while prompt attention is paid to all correspondence.

W. T. H.

[*The attention of our readers is called to the new address of the New England office—178 Devonshire street, Boston.*]

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
178 Devonshire Street, Boston, July 9, 1888.

Personals.

Mr. Geo. T. Manson, of the Okonite Company of New York, passed *quietly* through this city last week en route for his summer residence in Eastern Massachusetts, where he will pass a fortnight's vacation among his relatives.

Mr. Ben Willard, who for some time past has represented the Thomson-Houston Electric Company's interests in Hartford and surrounding sections, has resigned his position, and will, in the future, be located in Chicago, where he will be identified with other electrical enterprises.

Novel Use for Electric Lights.

I have it from good authority that the headquarters of the encampment of the Second Brigade Massachusetts Volunteer Militia, at Framingham, Mass., are to be lighted with Edison incandescent lights supplied from the New York Electrical Accumulator Company's storage batteries.

The Jarvis Engineering Company.

During the past six weeks the business of the Jarvis Engineering Company, of Boston, has been the largest since its organization, both in sales and in the number of plants installed; its sales of the Armington & Sims engines alone aggregating over 1,500 h. p., and it has received orders for the setting of no less than 54 boilers with the Jarvis furnace during the month of June. The above shows the merit of this company's specialties and also of its class of work. The company report the outlook for business as being better than for years.

Electric Lights for Palmer, Mass.

The station of the Palmer Electric Light Company has been completed and the new double engines of the Armington & Sims type set in position ready for starting. It is expected to turn on the current early in July.

Dover, N. H., to Have More Electric Lights.

The Dover Electric Light Company, Dover, N. H., has just received another boiler of 150 h. p. for increase of that plant, speaking well for the management and also of the estimation of the electric light by the citizens of the city. This company furnishes the Thomson-Houston system of lighting, and the business of the company is under the management of Mr. H. W. Burgett, of Boston.

Thomson-Houston System.

From the manager of the electric lighting department of the Thomson-Houston Electric Company I have ascertained that electric light stations have been furnished recently as follows: At Woburn, Mass., 500 incandescent (alternating) lights; Winchester, Mass., 35 arc lights; Brockport, N. Y., 30 arc and 500 straight incandescent lights; Columbus, O., an increase of 150 arc lights; Brooklyn, N. Y., an increase of 45 arc lights.

The C. & C. Motor Company's New Branch.

A New England branch office of the C. & C. Electric Motor Company, of New York, has been established in Boston, and is located at No. 19 Pearl street. I have been informed that a Mr. Claflin, of Providence, R. I., will have charge of the company's interests in this section.

Storage Batteries in Demand.

Mr. John T. Moriarty New England manager of the N. Y. Electrical Accumulator Company, reports business in his line as unusually active, and the outlook for a steady increase in the demand for storage batteries in all parts of New England decidedly encouraging. The peculiar merits of—and the innumerable uses for—the accumulator are beginning to become appreciated in this as well as in other sections of the country.

A New Electric Light Station.

The Fall River, Mass., Electric Light Company is building a new station, which, when completed, it is said, will be equal in its appointments to any building of the kind in the country. Messrs. John Post, Jr. & Co., of Boston, have been awarded the contract for furnishing the steam plant of the new station with a 60 h. p. Ide automatic steam engine, which, together with the engines, boilers and other appurtenances removed from the old station will give the company a large increase in its power capacity.

Accumulator Plant at Roxbury, Mass.

The central station for furnishing incandescent electric lights recently established at Roxbury, Mass., by Mr. H. C. Wirt, is now ready to start up. The current for the lights will be exclusively supplied by storage batteries manufactured by the New York Electrical Accumulator Company, comprising 200 cells of the largest type.

Contemplated Removal.

I am informed that the Thomson-Houston Electric Company contemplates removing its Boston offices in the autumn from 178 Devonshire street to the new and magnificent building on Atlantic avenue, adjoining the New York & New England Railroad depot. The building referred to is directly opposite the intersection of Federal street and Atlantic avenue, and is located in the midst of important and wealthy business interests. Mr. George W. Davenport, the manager of the Thomson-Houston Company's international department, has charge of the arrangements preparatory to his company's change of quarters, and the rooms for occupancy by the various departments will be selected and made ready under the supervision of this gentleman.

The Heine Safety Boiler.

Colonel Mier, of the Heine Safety Boiler Company, was on a business visit to Boston during last week. He reports the condition of business in his line among the electric lighting interests as very active. He informed me that the Columbus (Ohio) Electric Light Company, which has for some time been using Heine boilers aggregating 550 h. p., has just given the Heine Company another order for boilers having an aggregate of 500 h. p., thus giving a total boiler capacity of 1,000 h. p.

The Aluminum Brass and Bronze Company.

Last week I gave some notes on the formation of the above company. I may now add that its purpose is the manufacture of silicon and aluminum brass and bronze in sheets, wire, etc. It is an altogether new metal in this country, experimented on by some of our manufacturers, but with no great degree of success through lack of proper machinery. The new company will provide itself with a plant specially adapted for the manufacture and treatment of this metal, under the Cowles patents, and will, no doubt, meet with the same gratifying results that have attended its manufacture in Europe, where the product is finding general use in telegraph and telephone construction and is fast superseding other metals because of the economical advantages it offers in the construction of these lines. The officers chosen are Hon. F. J. Kingsbury, president. Mr. Kingsbury is the president of the Scovill Manufacturing Company, of Waterbury. The general business and financial manager and treasurer of the company is William Powe, a well-known and successful business man of Ansonia. Chas. S. Morse, for nine years connected with Wallace & Sons, of Ansonia, and for six years past superintendent of the Scovill Manufacturing Company, of Waterbury, will be manufacturing superintendent. Dr. Leonard Waldo, of Harvard and Yale universities, was chosen scientific expert and electrical engineer. F. J. Kingsbury, Jr., for five years past with the Scovill Manufacturing Company, and engaged with Dr. Waldo and Mr. Morse in their development of these alloys, was elected secretary. Thus some of the best business and practical manufacturing talent in the valley is combined in this company. The capital stock of the company is $250,000, all of which is subscribed. At the outset the new mill will furnish employment to from 250 to 300 hands. Location is still unsettled, but a decision will be reached in a few days. Immediately afterwards the erection of the mill will be begun and about six months will be required for its completion. It is reported that the mill will be started at Bridgeport.

Eastport Electric Light & Power Company.

The Eastport, Me., Electric Light & Power Company started up its lights (arc and incandescent) July 4. From the very beginning the lights are reported to have given thorough satisfaction, and numerous new orders for lights, both commercial and domestic, have been received by the company. The steam plant of this station was installed and equipped by Messrs. John Post., Jr. & Co., of Boston, and great credit is due this firm for the first-class quality of the engines, boilers, and everything connected with the equipment, and for their judicious and systematic arrangement of the entire steam plant.

W. I. B.

PHILADELPHIA NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
39 South Tenth Street, Philadelphia, Pa., July 7, 1888.

The Glass Workers Strike.

At the recent meeting of the American Flint Glass Workers Union, it was ordered that the usual shut-down should occur in July and August. Pursuant to this, the owners of flint glass works have given their hands notice of the customary vacation of six weeks. There are only half a dozen factories here, employing about 1,100 hands. The most prominent is that of Gillender & Sons, No. 145 Oxford street, where the shut-down will last until Aug. 15. Ruhrbacker & Herman and Gill & Co., of Richmond, will be closed for the same term. The factories of Fox & Son and Gustavus Sturm will probably be closed until the advent of autumn.

B. & O. Wires.

The fact that the wires and instruments in the office of the Baltimore & Ohio Telegraph Company at Ninth and Chestnut streets have been removed by the Western Union Telegraph Company will greatly strengthen the city's suit against the Baltimore & Ohio Company for the forfeiture of its bond in the sum of $50,000. This bond was filed in accordance with an ordinance passed by Councils on March 21, 1883, which provided that the company would not consolidate with any other owning a competing line, "or acquire by purchase or otherwise any such competing line of telegraph in the State of Pennsylvania or any other State." When the announcement was made last December that the Baltimore & Ohio Telegraph Company had been absorbed by its rival, the Western Union, the City Solicitor was at once instructed by Councils to take steps to forfeit the bond for $50,000, and suit was then begun. The company, in its defense, denies that any merger had occurred, and the case, which promises to be a very interesting one, will come up for trial in the fall.

Wharton Storage Cars.

The Wharton electric motor will be tested on the Lombard and South Streets Passenger Railway next week. The attempt was made several days ago to run a car equipped with a Wharton motor, but owing to some trouble with the tracks the attempt was not carried out. The trouble has been remedied, and the new car will now be tested. The officials of the Lombard and South are confident that electricity will ultimately take the place of horses for propelling street cars, and believe that the experiment will be successful.

Lighting the "Yorktown."

Lieut. Ten Eyck DeWitt Veeder, U. S. N., is in the city superintending the erection of the electric lighting plant in the new cruiser "Yorktown." He is the guest of Lieut. Conway, of the Hydrographic Office.

E. W. E.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
44 Lakeside Building, Chicago, July 7, 1888.

The Electrical Construction Company.

The Electrical Construction Company, who are the sole Western agents for the New York Telemeter Company, report a large and increasing demand for telemeters. Several large orders have recently been received by the company.

Chicago Rawhide Manufacturing Company.

The Chicago Rawhide Manufacturing Company, who manufacture a belt especially adapted for running dynamos and other machines where high speed is required, tell me that never before in the history of their business has the demand for their goods been equal to that of the present. Among recent orders for belting was one for different sizes for operating a large electric light plant at Toledo, O., and another for operating an electric light plant at Davenport, Ia., besides a large number of shipments to other electric light plants throughout the country. They also tell me that the demand for rawhide rope for power transmission is increasing very rapidly. They recently shipped a ton of it to a city in the East. For this rope, which is made endless, long life is claimed.

Boiler Covering.

Messrs. Shields & Brown Co., of 240 and 242 East Randolph street, manufacturers of sectional insulated air coverings for boilers, steam, gas and water pipes, report that their local trade is far in excess of previous year's business, and they are now negotiating for several large contracts with electric light plants. In addition their country trade has been unusually good during the entire summer, necessitating a large force of employés. They are building new machinery and making preparations to meet a prospective increase in their business this fall.

St. Louis Mo.

J. H. Siegrist, Jr., & Co., of St. Louis, Mo., agents for the Brightman Stoker Company, closed a contract with the St. Louis Steam Heating and Ventilating Company for four 60-inch Brightman mechanical stokers for burning slack coal and preventing the smoke, to be used under the boilers at the new Lionberger building, Eighth and Washington avenue. The same firms have executed contracts for four 60-inch stokers, to be used in the new Odd Fellows' Association building at St. Louis. This appliance ought to command more attention in electric lighting stations than it does.

E. L. P.

KANSAS CITY, July 3.

Telephone Troubles.

It is hard to tell which is the more important item of electrical news to-day, the proposition to compel the Kansas & Missouri Telephone Company to reduce its rates by the enactment of an ordinance or the general and all pervading dullness in all business of an electrical character. As the latter is common, not unexpected, not opposed (because opposition would be useless) and but little railed at, and discussed only to admit it and deplore it and hope for the quick coming of better times, I suppose the former will be given the palm for importance. Beyond these two, there is nothing. The proposition to compel the telephone company to reduce its rates is the result of the war in St. Louis.

This condition of the St. Louis case would not usually be deemed of such a character as to excite similar action in other cities, but Kansas City is always ready to undertake whatever other cities are trying, it being a point of honor with the citizens to allow no other city to get ahead of them. A number of the most active citizens talked themselves into being the "abused victims of an accursed monopoly," the contagion spread, the councilmen were importuned, the good old third-term mayor, Henry Christian Kumpf, was called on regularly in turn by every one of the excited business men and duly impressed with the enormity of the company's charges.

In the meantime the telephone company and Superintendent Smith are pursuing their usual vocations. The telephone cables are reaching out in all directions and the number of instruments is rapidly increasing. Superintendent Smith still smokes a long, black, strong cigar with equanimity, indulges as usual in his rare gift of story telling.

"The rates will not be reduced," said he; "the company will wind up first. Our rate of $72 for each telephone within three-quarters of a mile of 'central' and of $9 additional for every additional quarter mile is already at the lowest notch. These agitations for reduced rates are the result of the public's ignorance of the cost of a telephone plant or of the expense attendant upon its operation. Anybody in the telephone business will tell you these costs are enormous. If such an ordinance as the one contemplated is introduced in the council, the company will fight it in that body, and if it passes, will fight it through the courts. If finally defeated, I can promise you that the company will take every one of its telephones out of Kansas City, and the Bell Company in St. Louis will remove its instruments also if it is defeated in the courts."

The Western Electric Construction Company.

The Western Electric Construction Company has the contract for equipping the central station of the Fort Scott, Kan., Electric Light and Power Company and getting it ready for business generally. The plant will have a capacity of 2,800 lights, and will be first-class in every respect. The company has been and will be represented throughout the transaction by the Kansas City agency. A storage house has been established at Fort Scott now, and the supplies for the work are being gathered there. It is the intention of the company to establish a minor agency there. The Western Electric Construction Company has just finished the fitting up of a 600-light plant for the Elmo Hotel, Excelsior Springs, Mo. It is an Edison plant, with two dynamos.

The Loomis Company.

Harry M. Cutter has established here the only agency west of Cincinnati of the Loomis Electric Manufacturing Company, and is pushing "the best light in the world" for all it is worth.

Tunnel Lighting.

The Kansas City Electric Light Company's somewhat novel plan for lighting the tunnel of the Inter-State Elevated Railway Company's cable line in Eighth street has not yet been put in operation. The railway company is contemplating a change in

cars, and it would be useless to put the electric light fixtures in the tunnel for the present cars, if cars of a different size and shape will soon be substituted for them. The plan of lighting contemplates a projection from the top of the car upward which will strike parallel wires and make the circuit complete immediately upon the cars entering the tunnel, and upon exit, of course, the circuit would be broken and the lights go out. The Kansas City Electric Light Company has just put a new circuit of 325 incandescent lights in operation in the business centre of the town. The company has also secured the contract for putting a 15-arc and 1,000 incandescent light plant in the new Midland Hotel.

Thomson-Houston Plants.

The Kansas City agency of the Thomson-Houston Co. has recently secured a contract for 70 lights at Lawrence, Kan.; 50 lights at Excelsior Springs, Mo.; 800 lights at Fort Scott, Kan.; 30 arc and 500 incandescent at Oswego, Kan.; 70 arc and 1,000 incandescent at Pine Bluff, Ark.; and last and best, for equipping the electric railway at Wichita, Kan., known as the Riverside & Suburban road. This last named contract includes the complete electrical equipment for six miles of the single wire, overhead system. There will be six motors, six cars, two fifty horse-power electric generators, and the contract price is near $60,000. About one-third of the road will be built and operated this year, the remainder next year.

Hawkeye Apparatus.

Charles Grover, the general southwestern agent of the Hawkeye Electric Manufacturing Company, of Oskaloosa, Ia., reports having supplied the Hutchinson, Kan., Water, Light and Power Company with one 10, one 5, two 1 and two ½ horse-power motors; the Horton, Kan., Electric Light and Power Company with 25 arc and 300 incandescent lights; the Missouri Valley, Ia., Electric Light Company with a three and a one horse-power motors

A New Brush Plant.

Mr. Steele, representing the Brush of Cleveland, has secured the contract for establishing a 25-arc light plant in Washington Park, just east of the city.

The Southwestern Electric Supply Company has moved into uptown offices in the same building with the Kansas City Electric Light Company, the Thomson-Houston agency and Mr. Cone, of the Electrical Supply Company. The Southwestern Company has recently secured the general Western agency for the Baxter motor and Partrick & Carter's electric goods.

The Kansas City Steam, Light, Power and Heat Company proposes to establish four electric stations, with a total capacity of 10,000 incandescent lights and 1,000 arc. These will be operated simply as a branch of its steam business. No actual construction work has yet been done by the company, but it is employing an army of men in its preparatory work, which includes a minute survey of the city, the measurement of every room in the business portion, the location of every boiler, every dynamo, every electric light, every elevator, etc.

Miscellaneous.

The Haslett Electrical Illuminating and Power Company will soon begin work on a $60,000 central station.

Messrs. L. H. Holmes, W. P. Holmes and J. D. S. Cook have organized the Kansas City Electric Time Company for the purpose of manufacturing, selling and operating systems of electric clocks. The capital stock is $10,000.

ENGLISH NOTES.

LONDON, June 27, 1888.

The Post-Office and the Telephones.

An influential deputation waited upon the Postmaster-General on Thursday last to endeavor to enlist his sympathies on behalf of the United Telephone bill, which is now before Parliament, and to which I referred in my last letter. The deputation was introduced by Sir John Lubbock, M. P., and included several members of Parliament, together with the chairman and directors of the United Telephone Company. Mr. J. S. Forbes, the deputy chairman of the company, dwelt upon the facilities which had been given to the operations of the gas and water companies and other semi-public institutions throughout the country, compared with the restraints and difficulties which had been put in the way of the telephone companies. They were unable to deny that the public had too often good ground for complaint as to the imperfections of telephonic communication, especially in London. This was in reality owing to the want of proper facilities for the erection and control of their lines. It will be remembered that in the early part of last year a committee of the House of Commons had been appointed to consider the subject of overhead wires and had reported strongly in favor of permitting their continuance under the control of some competent authority. The recommendation of the committee had, however, remained unacted upon, and meanwhile the post-office, who by some accident had acquired the legal right to control the telephones, did nothing whatever to help them. The Postmaster-General in reply said the government could not promise to support the passage of the bill. The fact was that if the local government bill were passed during the present session, any arrangement which might now be made would probably be reconsidered by the new County Councils, within whose jurisdiction all such matters would fall. This alone seemed to him sufficient reason for postponing the consideration of the subject until the following year. The telephone patents would expire shortly and then the government might be able to deal with the whole question of telephonic communication upon a comprehensive basis. As may easily be supposed, the deputation were not at all pleased with the reception they had met with, and a consultation was held directly afterwards, at which it was decided to drop the bill for this session.

Electric Traction on the Underground Railway.

The Metropolitan Railway Company, whose lines, as your readers are probably aware, run chiefly underground, announce that they hope to commence electrical traction in October or November next. Several electric locomotives are now building, each of 600 h. p., the steam engines at present in use being of about 450 h. p. Secondary batteries will be employed, but it is very difficult at present to obtain technical details of the manner in which it is proposed to carry out the scheme. From an economical point of view, it is perhaps worth while to mention that the company will be enabled to dispense with the services of one man on every train. The Metropolitan trains carry two guards, one at either end; but as only one man is required to drive the electric locomotive, the front guard will ride with the driver and the stoker will be dispensed with. The present time happens to afford a favorable juncture for the introduction of electric traction upon the underground section of this line, inasmuch as the company are carrying out a considerable extension of their system in the direction of Aylesbury, and in any case additional plant would shortly have been ordered for this service. It is their intention, if possible, to transfer their present steam plant to the Aylesbury open-air line, and to work the underground portion entirely by electric traction. Electrical engineers here cannot avoid some feeling of anxiety in connection with this scheme. Any failure or imperfect success would prove a serious blow to the prospects of electric traction in this country for a long time to come; and it is generally felt that the employment of secondary batteries, although convenient during the purely experimental stage, must seriously add to the risk of disaster as well as to the cost of working.

Leamington.

I learn from a very good source of information that the complaints which have been so rife in reference to the central station at Leamington have but a slender foundation in fact. It appears that the borough of Leamington is a prey to the most violent political factions, and everything that is done by either of the rival parties is vehemently attacked by their political opponents. Mr. Chamberlain, of the firm of Chamberlain & Hookham, who have carried out the installation at Leamington, happens to be a relative of Mr. Joseph Chamberlain, the well-known politician. In the Leamington town council, therefore, the opposite political party is determined to prove that the electric lighting scheme is a total failure. Owing to this cause the number of break downs, short circuits, burnt up armatures, extinguished lamps and other mishaps, is said to have been magnified to a truly appalling extent. However this may be, nothing could have been more unsatisfactory as regards the interests of electric lighting in general than this unfortunate state of affairs. It is very seldom, indeed, in this country that political rivalry is carried to the extreme of discrediting an industrial enterprise of this character, and it is difficult to believe that the story that has been told discloses the whole truth of the matter.

The Electric Lighting of Trains.

The electric lighting of railway carriages, as carried out by the Great Northern Railway Company, has made considerable progress. The arrangement adopted is designed by Mr. Radcliffe Ward, and consists of a dynamo and set of accumulator cells which are carried in the guard's van. The dynamo is driven from the axle of the van through a special gearing device of Mr. Ward's by which the direction of rotation of the dynamo is constant and independent of the direction in which the van is moving. The light meets with much appreciation from the passengers.

THE TELEGRAPH.

Columbia, S. C.—The Horry Telegraph and Telephone Company has been formed with the modest capital of $325.

T. M. B. A. assessment No. 219 has been made to meet the death claims of F. G. Lyon, H. C. Beach and F. K. Meade. The last two members had held certificates since 1870.

Heavy Work.—It is now stated that the grand total of extra telegraphic work during the Republican Convention at Chicago amounted to 14,525,000 words. The previous estimate was about 10,000,000.

Franco-English Cable Service.—A special dispatch from London, of July 3, says: The English and French governments have agreed to work jointly, on and after Jan. 1, 1889, on the submarine cables between France and England. The tariff will be 20 centimes a word. A direct cable between Liverpool and Havre will be established under the arrangement.

Operators Discontented.—There has been some talk in the newspapers during the past week of a proposed strike among the operators during the ensuing election campaign, when certain demands for higher pay or the equivalent, in shorter hours, will be made. Trouble is denied at the Western Union office, but there can be no doubt that a general agitation will be carried on for both concessions.

Cleveland, O.—The Superintendent of Fire Alarm Telegraph of Cleveland, O., in his annual report for the year ending Dec. 31, 1887, after referring to the number of new poles set and old ones removed, the quantity of new wire strung and old wire taken down, says: "7,384 feet of Okonite insulated wire was placed, and works well." Further on in the report, referring to underground wires, he says: "The Okonite insulated wire is working much better than any aerial line now in use in this department."

THE TELEPHONE.

Siloam Springs, Ark.—The Siloam Springs Telephone Company has been organized with a capital stock of $2,500.

New Haven, Conn., is to have a fine new building put up for telephone purposes. It is also reported that the writing telegraph is to be introduced into the city.

Mexican Telephone.—A dispatch was received at the Mexican Telephone office in Boston last week, announcing that an offer of $5,000 had been made by the party against whom suit for infringement of patents was brought to compromise. The offer was declined.

Venezuela.—The Boston *Post* publishes a neat exposé of the schemes of the American Telephone Company, which appears to be making an effort to repeat the operations that arrested public attention some months ago. The company proposes, as before, to work in Venezuela, which, it is well-known, is held under exclusive concessions by the Intercontinental Telephone Company, whose business has been steadily developing there for the past four years.

THE ELECTRIC LIGHT.

Sea Isle City, N. J., rejoices in a fine new Edison plant.

St. Johnsbury, Va., has appropriated $1,300 for electric lighting.

Passaic, N. J., wants bids on arc lighting with lamps of 1,200 and 1,800 c. p.

Harlem, N. Y.—The Harlem Lighting Company has declared a dividend of 3 per cent.

Natchez, Miss.—Mr. J. H. Andrews is negotiating to put in a Van Depoele plant at Natchez.

Texas.—Eagle Pass and Piedras Negras propose to have an electric light plant in common.

Boston, Mass.—The Boston Electric Light Company has declared a dividend of 1½ per cent.

Orange, Tex.—Lutcher & Moore are interested in a company forming at Orange to operate electric lights.

Little Rock, Ark.—The plant sold by the Fort Wayne Jenney Company to the city of Little Rock is to cost $27,000.

Boonville, Mo., is interested in a fight now waging between the local gas and electric light companies as to rights and franchises.

Biddeford, Me.—The Traders' Electric Light Company has elected Mr. W. Emery as president and Mr. G. F. West as secretary and treasurer.

The Gaston Electric Headlight Company, of Sparta, Ill., has been incorporated by J. E. Gaston, J. R. Denier, D. P. Barker and R. J. Harmer.

Brazil.—The Brazilian Thomson-Houston Company has been incorporated at Portland, Me., by G. W. Davenport and others, with a capital stock of $500,000.

Utica, N. Y.—The Mohawk Valley Electric Light Company has been incorporated by C. K. Grannis, D. O'Connell and others, with a capital stock of $35,000.

Knoxville, Tenn.—Mr. C. H. Hudson is President and Mr. W. H. Simonds Secretary and Treasurer of the Knoxville Electric Light and Power Company, lately formed.

Orange, Mass.—The New Home Sewing Machine Works are so extensive as to take, it is said, no fewer than 90 arc lights. A plant of the Waterhouse system is being put in.

Chicago, Ill.—The Thirty-first Street Electric Light and Power Company, of Chicago, has been incorporated, with a capital stock of $50,000, by J. Shimers, J. J. McEvoy, S. King and O. O'Neill.

Deland, Fla.—It is reported that the Deland Electric Light Company, formed not long since, has shut down, causing the town to go back to oil. We shall be glad to hear that the company has braced up again.

Colfax, W. T.—The Colfax Electric Light Company, which was recently organized with Mr. J. H. Perkins as president and Mr. C. B. Hopkins as secretary, will put in an Edison plant and expects to be in operation in 60 days.

Pittsburgh, Pa.—The Hill Clutch Works, of Cleveland, have been given the order for the power transmission machinery of a small electric light plant for Jones & Laughlin at Pittsburgh, as well as for that in the Gusky building.

Crawfordsville, Ind.—The designs and proposal of the Hill Clutch Works, Cleveland, O., have been accepted by the Crawfordsville Gas & Electric Light Company, and they will have plant in by Aug. 1.

Newburgh, N. Y.—At the Receiver's sale, the property of the Newburgh Electric Light Company brought $30,000. It will be remembered that the company was placed in financial difficulties by the defalcations of the treasurer.

More Litigation.—The Thomson-Houston Electric Company has brought suit against the parties operating the Heisler system of street lighting at Fishkill, N. Y., for infringement of patent covering the film cut-out for series incandescent lighting.

New York City.—The local Brush company has written to the Board of Electrical Control expressing its desire to meet every requirement, and stating that it has obtained cable for use in the subways. The cable in question has been furnished by the Standard Underground Company.

Theatre Lighting.—There are ten theatres and music halls, not reckoning Olympia, illuminated by electricity in London. There are thirteen theatres in Paris possessing installations of the electric light, and eleven more in other parts of France; two in Spain; one in Belgium; thirteen in Germany; several in Denmark, Sweden, Norway, and Austro-Hungary, Italy and Russia, and one in Finland.

A Word of Caution.—The *Engineering and Mining Journal* has a well informed article on the subway question, and offers some advice as to putting arc-light wires in the present conduits. It says: "We understand that in the New York conduits there are instances in which the gas pipes actually traverse the manholes. To carry high tension currents through such places is wanton folly. * * * This risk is continuous, and until it has been more adequately provided for, no one can truly say that the problem has been solved."

Athol, Mass.—All but three shares of the Athol Electric Light and Power Company are owned by gentlemen in Maine who are largely interested in manufacturing business in that State. And it is said that, should they receive satisfactory encouragement in their electric lighting business, they will purchase a water privilege in town, not only utilizing it for the electric business, but also by introducing a new branch of manufacturing industry in the place.—*Mfrs. Gaz.*

Springfield, Mass.—H. S. Hyde has retired from the management of the Springfield Electric Light Company, to whose interests he has devoted considerable attention for a number of years, and is succeeded as treasurer and director by A. L. Fennessy. The company has now begun to pay two per cent. quarterly dividends, and is in a prosperous condition. It is still unable to supply all of the many calls for incandescent lights, but with the new plant, which is to be immediately erected on the river bank, will be in a position to take all the customers who offer.—*Light, Heat and Power.*

Vineland, N. J.—Mr. Geo. W. Silsby, representing the Edison Electric Illuminating Company, is asking for an exclusive

franchise of the borough of Vineland for the space of ten years, with the privilege of renewal under proper restrictions, which may be thought necessary at the end of ten years. In the petition, it is set forth that the Edison Illuminating Company would erect a plant of 1,000 lights—more or less—sixteen candle-power, and would sell the same to the citizens at $1 per light a month, to burn eight hours each evening. To the borough—for streets—as many lights as may be needed will be furnished at $10 per year, and will burn all night. A proviso is to be found in this communication, which says that the citizens must agree to take 600 lights.—*Lt., Ht. & Pr.*

APPLICATIONS OF POWER.

Winston, N. C., will, it is said, soon have a Sprague electric road in operation.

New Orleans, La.—The Carrollton Railroad Company is awaiting a permit to operate by electric motors.

Asheville, N. C.—The Asheville Street Railroad Company is busily at work equipping its road for electrical operation.

Danville, Va.—The Danville Electric Motor Company has received a permit to operate a street railroad by electricity.

Tampa, Fla.—The Tampa Street Railway Company is looking into the claims of electric railways, and proposes to adopt electricity.

Seattle, W. T.—Now that the franchise has been obtained at Seattle for an electric railway, it is said that the work will proceed briskly. A Thomson-Houston plant to cost $60,000 is talked of.

Motors in Japan.—The Sprague Company has received from Tokio, Japan, reports on the operation of the electric fire pump sent thither for use in the Mikado's new palace. The trials that have been made yield results exceeding the most sanguine expectations. Although the pump is on a temporary foundation and has to draw its water 12 feet, it does much more than was claimed for it. So strong is the opinion in its favor among the officials of the household, that it is probable that five or six of these machines will be placed in the palace.

Syracuse, N. Y.—The Jarvis Engineering Company have orders for the steam plant of the Third Ward Railway Company, of Syracuse, to operate electrically, and will install two boilers of 100 h. p. and two engines of 80 h. p. each. There are also two other power stations being equipped by them, one being of 500 h. p.

MISCELLANEOUS NOTES.

The Electro-Dissolvent Company, of Jersey City, has been formed by G. F. Gantz and others, with a capital stock of $50,000.

Chicago, Ill.—The Chicago Insulating and Construction Company has been formed by B. Palmer, E. A. Mulhard and I. M. Hunter, with a capital stock of $250,000.

Utilizing Wind Power.—The *Iron Age* devotes an editorial to the discussion of the utilization of wind power by means of dynamos and storage batteries, and considers the line a very promising one to work upon. The time is ripe for an extensive development of this field, especially in the West, where, as our contemporary says: "The windmill for pumping has become a familiar landmark."

The Electric House Wiremen's Union.—Mr. R. F. Nagle, delegate to the Central Labor Union, contributes to the New York *Evening World* a sketch of the above union. It is attached to the Building Trades Section, and has been in existence since March 29, 1888. It includes all engaged in inside wiring, outside wiremen being ineligible. The initiation fee is $2, and the monthly dues are 35 cents. The wages are stated to range from $2.50 to $3.50 per day, with nine and ten hours work.

A Recognition of Engineering.—One of the best features in the able policy that has governed the management of *Scribner's Magazine* has been its recognition of the great interest and importance of engineering topics or problems, and its success in securing contributions from those whom we all recognize to be leaders in the arts and sciences. Our readers will not have forgotten the article it published from Mr. F. L. Pope on electric motors, and they have doubtless been glad to follow, as we have, the fascinating studies of railway triumphs and developments now appearing. This month Mr. John Bogart has an excellent article on what may be called the civil engineering side of the subject, and next month Mr. M. N. Forney will handle, as an authority, quite another part of it in "American Locomotives and Cars." *Scribner's* is conspicuously the first magazine to give modern engineering any part of adequate treatment, as being something that concerns the public, and we are convinced that to many a non-professional reader the admirable literary work that has enabled him to fairly master technical mysteries must have come as a more than grateful surprise.

BUSINESS NOTICES.

Jordan & Gottfried, 208 Canal Street, N. Y., carry a complete stock of iron and brass machine and wood screws, bolt cap and set screws, taps, dies, files, twist drills, brass and rubber tubing, rod and sheet copper, brass, German silver, steel and iron wire, shafting, tools, etc.

The Partz Electric Battery Company, of Philadelphia, having found their old quarters at 1,723 Chestnut street too small, have leased the large building at 636 Arch street, same city. They are now prepared to fill all orders promptly, and in addition to their large line of Open Circuit and Gravity and Motor Batteries, have a full line of small Motors and Dynamos. Send for their price list and catalogue, or write to them stating what you want.

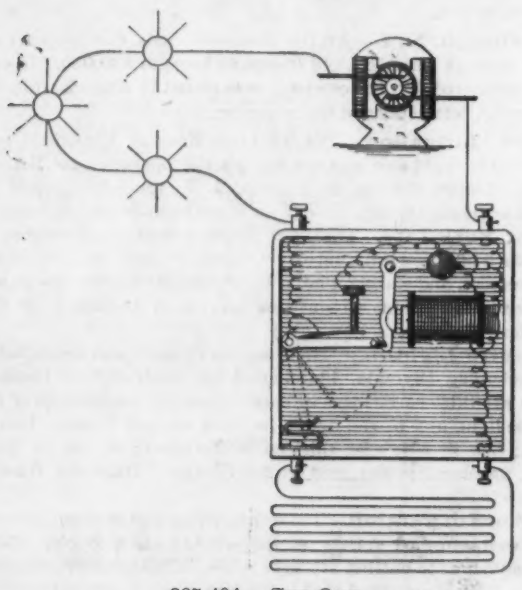
OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS DATED JULY 3, 1888.

385,344. Porous Cup for Galvanic Batteries; Asahel K. Eaton, Brooklyn, N. Y., Assignor of one-third to Colin M. Thompson, of same place. Application filed Oct. 7, 1887. The cup is formed of asbestos, then soaked in a suitable carbonaceous substance and silicate of soda, after which it is allowed to dry, and subjected to a high heat.

385,357. Combined Speaking and Signaling Apparatus; John E. Kelly, Camden, N. J. Application filed May 12, 1887. Bells are arranged at each end of a speaking tube, and the act of lifting the tube to the mouth or dropping it when finished rings the bell at the opposite end of the tube. This is accomplished by a system of electric circuits.

(1) 385,363. (2) 385,677. Switch Signals; Adelard F. Martel, of Montreal, Quebec, Canada, Assignor of three-fourths to Jean Baptiste Amede Mongenais, of Rigaud, and Toussaint Brosseau and Marie M. Philomiene Craig, both of Montreal, Quebec, Canada. Applications filed respectively Oct. 22 and Oct. 29, 1887. (1) An alarm signal is rung automatically so long as a switch remains in its abnormal position. (2) A device for signaling trains when a bridge is burned or injured. A combustible cord is stretched the length of the bridge, and



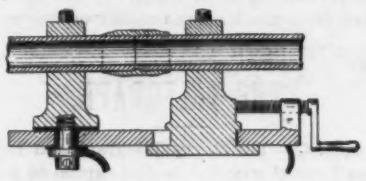
385,494. CUT-OUT.

connected at both ends with a suspended weight. If the cord burns or is rent the weights fall and complete an electric circuit, which controls a semaphore or other signal.

385,379. Current Collector for Series Electric Railways; Sidney H. Short, Denver, Colo., Assignor by direct and mesne assignments to the United States Electric Company, of same place. Application filed Feb. 19, 1887. A bar of insulating material provided with contact conducting strips connected to said bar, and adapted to move thereon when the bar is bent, whereby buckling of the strips is prevented.

(1) 385,384. (2) 385,385. (3) 385,386 and (4), 385,647. (1) Method of Joining Pipes by Electricity; (2) Method of Electrically Welding Chains and Links; (3) Direct Electric Welding Machine, and (4), Electric Meter; Elihu Thomson, of Lynn, Assignor of Nos. 1, 2 and 3 to the Thomson Electric Welding Company, of Boston, Mass. Applications filed, respectively, Aug. 22, 1887; Aug. 22, 1887; Oct. 17, 1887, and April 6, 1888. (1) The invention consists in bringing the ends of the pipe to be united near or in abutment with a sleeve or a collar applied at the juncture, and then passing a heavy electric current through the parts, of a volume sufficient to heat the same to a welding, brazing, or soldering temperature, so as to permit the sleeve to be firmly united to the ends of the pipes by welding through pressure or hammering, or by brazing or soldering, with preferably the application of proper soldering or brazing materials. (See illustration.) (2) U-shaped halves of chain links are brought together and welded at the juncture by passing a heavy current through them. (3) Instead of the alternating machine and the converter interposed between the generator and clamps, a continuous current generator connected directly with the clamps is provided. (4) A current controller governing the flow of current to the meter and a controller magnet or electro-responsive device adjusted to permit an increase in the flow of current to the meter when the current to be measured falls below that to which the meter responds normally. This is to overcome the insensitiveness or sluggishness of the meter.

385,388. Electric Signal Transmitter; Wm. C. Thompson, Minneapolis, Minn. Application filed April 19, 1887. A main electric circuit, a local electric circuit, a call box in the



385,384. METHOD OF JOINING PIPES BY ELECTRICITY.

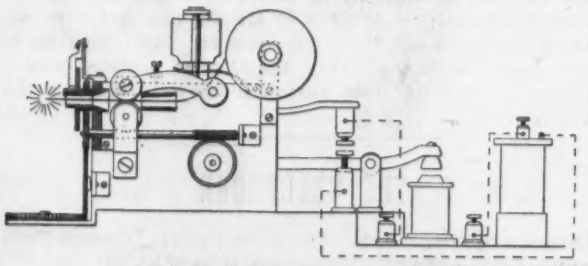
main electric circuit, having an answering device inoperative under the normal force of the main and local circuits, self-inductive coils in the local circuit and switches for breaking the local circuit and closing the local and main circuits in series.

385,390. Secondary or Storage Electric Battery; S. L. Trippe, Denver, Col., Assignor to the Electric Storage, Light and Power Company. Application filed Aug. 27, 1885. A porcelain box within a wooden box, the former divided into cells, the walls of which are perforated.

385,393. Magnesium Lamp; Theodor Weisser, of Vöhrenbach, near Villingen, Baden, Germany. Application filed Aug. 9, 1886. The spring controlling the movement or feed of the band of magnesium is wound up by the action of an electro-magnet whose circuit is closed by reason of the consumption of the band. See illustration.

385,413. Electric Railway and Lighting Appliance; Isaac W. Heysinger, of Philadelphia, Pa. Application filed April 21, 1887. A system of gas and electric distribution, consisting generally in the location of electric generators at different stations along the line of the road, connecting all the stations by gas supply pipes for supplying fuel to the engines which drive the dynamos and an electrical system for controlling gas valves, etc.

385,436. Electric Lamp Socket; John S. Adams and Albert W. Morrell, of Indianapolis, Ind., Assignors to the Jenney Electric Company of Indiana. Application filed April



385,393. MAGNESIUM LAMP.

10, 1888. This lamp is designed for use in series circuits. The operation of the cut-out also locks the lamp to its socket so that it cannot be removed while in circuit.

385,458. Dynamo-Electric Machine; August Harding, Oakland, Cal. Application filed June 11, 1887. A novel construction of frame for supporting the commutator and armature.

(1) 385,482. (2) 385,528. (1) Test Signal Circuit and (2) Spring Jack Switch; Charles E. Scribner, Chicago, Ill., Assignor to the Western Electric Company of same place. Applications filed, respectively, Dec. 27, 1886, and Aug. 3, 1887. (1) Details. (2) The free end of the spring is crimped to make it more durable and less liable to become loose upon the board.

385,493. Suspension Arm for Electric Lamps; James J. Wood, of Brooklyn, N. Y. Application filed Feb. 13, 1888. For description see THE ELECTRICAL WORLD, Dec. 10, 1887.

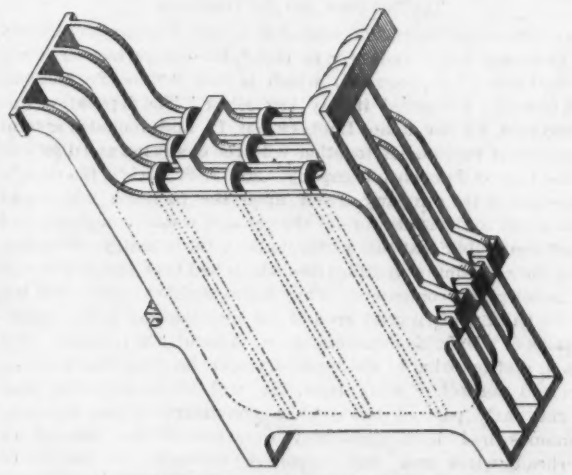
385,494. Cut-Out; Charles D. Wright, Petersburg, Ill. Application filed Jan. 31, 1888. A device for throwing in resistance when work is removed from a circuit, to prevent burning of the armature by the heavy current generated before the regulating device can act. See illustration.

385,539. Electric Switch; Edward F. Bergman, Frankfort, N. Y. Application field March 29, 1888. A switch lock formed of two parts carrying the circuit wires, one of which is broken within the block. A pivoted switch lever is secured to the block, and is used to connect the parted ends of the conductor.

385,556. Medicated Electric Belt; Cyrus U. Hoke, Reading, Pa. Application filed March 26, 1888. The pockets of the belt contain alternately suitable medicinal substances and voltaic batteries connected by a conducter.

385,558. Secondary Battery; Frank King, of Fulham, County of Middlesex, England. Application filed April 4, 1888. Patented in England, Dec. 10, 1887, No. 17,047. Claim: In a secondary battery, an element consisting of two or more plates mechanically united at two or more points, combined with a second element consisting of plates interleaved or alternating with the plates of the first element, both elements being located in an inclosing cell, containing an electrolytic liquid. See illustration.

385,565. Electro-Mechanical Type-Writer; James F. McLaughlin, Philadelphia, Pa. Application filed March 26, 1887. The operation of a type-writer key imprints the letter



385,558. SECONDARY BATTERY.

at the sending station and also sends an electric current over the line to a similar machine, causing it to print the same letter by a similar type-lever.

385,576. Insulated Conductor; Clarence C. Sibley, of New York, N. Y., Assignor to the Splitdorf Wire Company, of same place. Application filed Jan. 28, 1888. Layers of threads, rubber and asbestos are applied to the conductor.

385,664. Telephone Transmitter; Julius Emmner, Jr., Washington, D. C. Application filed March 22, 1887. The electrodes are oblong shaped pieces pivoted upon a bar so as to be balanced, one end resting against the diaphragm.

385,672. Electric Railway; Rudolph M. Hunter, Philadelphia, Pa., Assignor to the Electric Car Company of America, of same place. Application filed March 18, 1886. A method of braking the electro-motor, which consists in increasing the counter electromotive force until it is above the initial E. M. F. The machine is then a generator, and the car moves by its momentum. A closed circuit is then established from the source of energy and operates a friction brake.

385,675. Electric Motor and Dynamo Machine; Orazio Lugo, New York. N. Y. Application filed May 1, 1888. For description see page 15, this issue.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patents issued since 1866—can be had for 25 cents. Give the date and number of patent desired, and address Johnston's Patent Agency, Potter Building, N. Y.